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ABSTRACT

This booklet contains the second in a series of three interdisciplinary units which focus specifically on the Pacific Ocean and its surrounding countries. The unit, intended primarily for lower to middle secondary level, consists of readings and interdisciplinary activities (science, art, social studies, English, and home economics) presented in two parts. Part 1 examines fishing in traditional societies (salmon fishing in the Puget Sound area long ago, aboriginal fishing culture, the fish hook, and changing traditions in the Solomon Islands) and fishing in industrialized societies (the Japanese tuna fleet, Australian prawning, and salmon fishing in Oregon). The second part focuses on what happens after fish are caught, considering marketing and processing, ways of preserving fish (chilling/freezing, salting, drying, smoking, pickling, and canning), and the social, cultural, and moral issues involved in the consumption of fish. A case study on the effect of changing diet in Tonga is included. (JN)

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HARVESTING THE OCEAN

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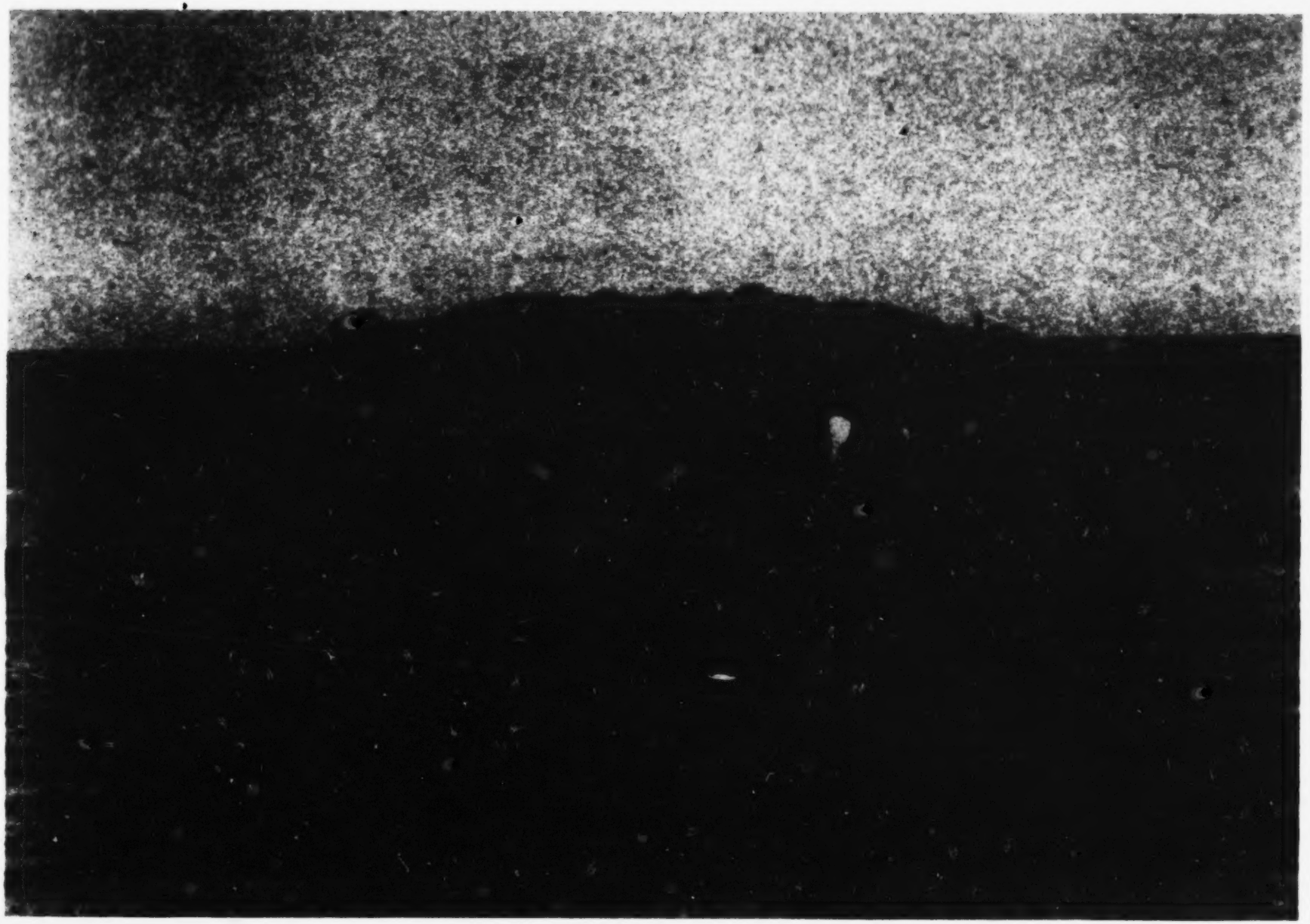
One of the aims of the Pacific Circle Consortium is the development of educational materials with an international perspective, particularly materials that take into account the half of the earth's surface covered by the Pacific Ocean.

The Consortium works on the assumption that educational materials about other people and other cultures will be most accurate and genuine when developed jointly, by people from the country using the materials and people from the country being studied.

Harvesting the Ocean includes material from many Pacific countries and cultures. It has been developed and published as the result of co-operation between many people in a number of different countries. For their assistance and co-operation, and especially to Helen Connell, and to the Northwest Regional Educational Laboratory, Portland, Oregon, USA, we express our thanks.

2. The Harvest



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Introduction

Harvesting the ocean is still primarily a **hunting** activity.

For thousands of years many societies have relied on the sea for their **main food source**.

Today all the peoples of the Pacific area make use of the plants and animals of the ocean as food sources. All are involved in some way with one of man's oldest hunting activities, although the means used differ greatly from one culture to another.

Part I of this booklet looks at the **harvesting methods** of different fishing cultures in the Pacific area.

It begins by looking at fishing in three **traditional societies**:

—the Puget Sound Indians of North America
—the coastal Aborigines of Australia
—the Solomon Islanders of the western Pacific.

By traditional societies we mean those which are organised on the basis of **long established** and generally accepted customs and methods of procedure.

If we look at the history of traditional societies we find that there has usually been a very **slow rate of change**. The most common reason for a slow rate of change is **geographic isolation**.

Part I also looks at fishing in three **industrialised societies**:

—Japan
—Australia
—The United States.

By industrial societies we mean societies organised on the basis of systematic labour for the production of commercial goods. To survive, a person needs only food and basic shelter. Any goods produced over and above survival needs, and that are used in trading and exchange, we call commercial goods. Modern industry is based upon this kind of trade.

In looking at the differences between fishing in traditional and commercial societies we will be focusing on the following questions.

1. Habitat

What are the different **marine environments** that people live in?

How do these affect the kind of **society** they live in, in particular the **physical organisation** of that society? For example, do they live in large or small villages or towns?

How does their marine environment affect the kind of **work** that people do? For example, are they fishermen or ship-builders? If they are fishermen, what kind of fishermen?

What kinds of **marine life** are available?

What kinds of **raw materials** are available for making boats and hunting implements?

What kinds of **skills** are involved in hunting marine life?

What kinds of **risk** are involved?

2. Society

How has the kind of society that fishermen live in influenced the ways in which they hunt? For example, what influence does their **religion** have on their attitudes to (a) the ocean and (b) the ways in which they hunt?

Do the fishermen hunt as a **community** and share their catch? Do they hunt as individuals and **trade** their catch for other items?

What is the **technology*** available to the society?

What kinds of hunting implements and aids are used?

What kinds of boats are used? Are they heavily or lightly equipped?

What kinds of skills are involved in making them?

3. Economy

Do the fishermen work within a **subsistence** or a **commercial** economy?

What are the common items of trade and exchange? What forms of money, if any, are in use?

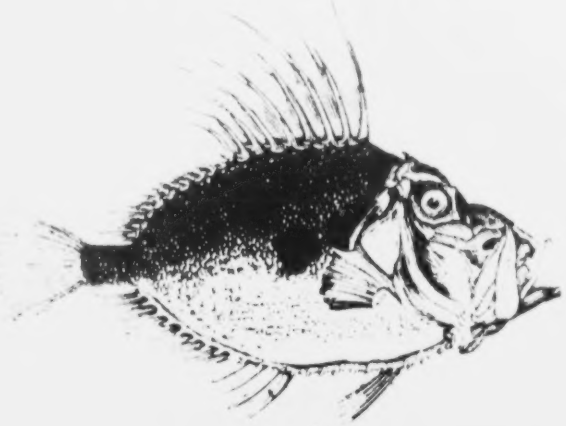
Do the fishermen hunt only for **subsistence**, that is for their own survival needs, or to sell their fish **commercially**, in exchange for money?

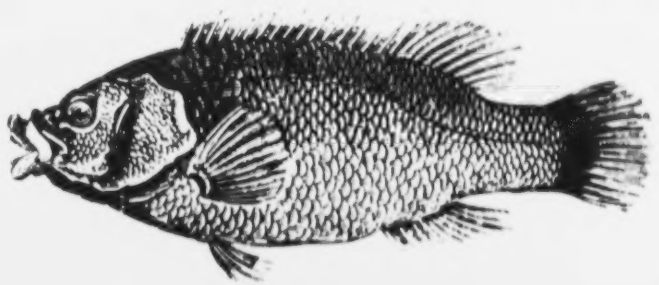
When the fish is sold is it bought directly by the consumer or is it handled by several other people first? For example

—a transport operator
—a food processor (a cannery for example)
—a middleman.

There are various kinds of middlemen: fish marketers; fish-shop owners; restaurateurs.

*technology — from the Greek: the science of the practical arts.





1.0 Fishing in Traditional Societies

All people are dependent upon and influenced by their environment. The manner in which different cultures develop reflects the way in which people adapt to their surroundings.

Most early coastal peoples depended upon the sea as a food source. Their use of the sea's food resources is relected in other aspects of their culture — in their myths and legends, their art and their domestic life. Fishing is not only a means of survival, it has become a way of life.

1.1 Salmon Fishing in the Puget Sound Long Ago

The Puget Sound is in the State of Washington on the North West Coast of America.

A 'sound' is a relatively narrow channel or stretch of water, especially one between the mainland and an island.

To the early Puget Sound Indians, fishing was a way of life and they had a highly successful fishing technology. We may think of the early indian tribes as primitive hunters but in fact their methods were far from simple — they involved complex and innovative skills that developed, over time, in response to the conditions of a specific environment.

The Puget Sound environment was a very rich one and provided all the natural materials and resources necessary to develop a highly skilled fishing technology.

1.1.1 Fishing Legend

Telling legends was a traditional way of teaching skills among Puget Sound Indians.

The Salish Indian tribe, now living on an eleven-tribe reservation near the mouth of the Skagit River in northern Washington State, attributes its good fishing and prosperity to the gift of the beautiful maiden of Deception Pass.

The story below was originally chanted while tribal dancers acted out the highlights to the beat of a drum. By 1930, the words of the chant had nearly passed into extinction, and only a few old-timers could outline the story.

Chief Sampson credits the late Charlie Edwards with saving the legend by carving an image of Princess Ko-Kwalawoot on the Swinomish Reservation story-pole. Edwards, whose Salish ancestors were famous for wood carving and canoe making, directed the making of the pole in 1938.

Now the Salish pass the legend on to their children as a family ritual. They believe that as the currents flow back and forth through Deception Pass, Princess Ko's long hair may be seen drifting with the tide. The Salish say she will always be there to look out for the welfare of her people. She is their guiding spirit.

The legend of the Maiden of Deception Pass reflects the importance of the sea — as a food source and a way of life — to the Salish Indians. The Indians personified the sea, endowing it with god-like characteristics; they made the sea-spirit someone they could talk to, who could talk to them, someone who could give or withhold favours of the sea. By personifying the sea, which was their source of food and of life, the Indians could account for the caprices of nature in human terms; if the salmon run was small the sea spirit was angry; if the sea teemed with fish and the clamming was good, the sea spirit was pleased with the tribe.

This attempt to explain a phenomenon of nature in understandable and, by our standards, simple terms is characteristic of myths and legends. The Greek concept of Poseidon as god of the sea and the Roman deity Neptune are not very different from the Indian representation of a sea-spirit controlling the success or failure of fishing. In many cases the deities of the mythologies of widely scattered societies overlap.

The Maiden of Deception Pass

Long before the first pioneers carved settlements out of the wilderness, and even before the first buck deer grew antlers, a beautiful Salish Indian princess named Ko roamed the beaches of Deception Pass.

It is said that Ko's long hair was blacker than charcoal and her eyes browner than the bark of the tallest fir tree. The story of her great beauty spread throughout the land, from the top of the tallest mountain to the bottom of the sea.

Salish Indians were known as fish eaters because the sea furnished them with most of their food. While men caught salmon and demersal fish, it was the duty of tribal maidens to dig clams and collect shellfish from the intertidal zone on the beach.

One day, after the maidens had gathered shellfish, Princess Ko was helping wash the catch at the water's edge. Suddenly one of the shellfish slipped from her hand and slid into deeper water.

She tried to retrieve it, but it slipped from her grasp again and again, edging each time into deeper water. Soon Princess Ko found she was in water well over her waist.

As she turned back to the beach, a large hand rose from the sandy bottom and grasped hers firmly, preventing her escape. The princess was terrified as the swift waters of Deception Pass swirled around her body, and she fought to free herself. But the powerful hand would not loosen its grip.

A voice coming from beneath the surface of the water instructed her not to struggle or be afraid. 'I'm the son of the great spirit of the sea,' the voice gently told Princess Ko. 'You are more beautiful than all the skies. I am holding your hand only to admire your great beauty.'

On the condition that she would visit him often, the spirit son released her hand. Princess Ko kept the promise and met him many times. During each meeting the spirit son spoke soothingly to her, holding her hand longer and longer. He told her of the many beautiful things that were in the sea, and finally he asked the princess to be his bride.

'Only my father can give me in marriage,' Princess Ko explained.

'Then I will go to the shelter of your father and ask for your hand,' the spirit son replied. He emerged from the water and followed Princess Ko to the Salish village.

As he walked through the village, people stared at the stranger who had eyes like a fish and skin covered with barnacles. 'Can this be the future husband of our beautiful Princess Ko?' they asked.

In his presence the village detected a chill as though icy winds were blowing. 'Surely this creature must be from the spirit world.' the people whispered as he passed.

Her father was angered at the thought of his beautiful daughter marrying a barnacle-covered sea spirit. He tried to dismiss the idea by saying, 'No, my daughter cannot go into the sea to live with you. She would die.'

'On the contrary,' the sea spirit replied, 'she will live.' He explained that the spirits of the sea would give her eternal life and be very good to her. 'I love her dearly, and I will see that no harm comes to her.'

The father did not want his daughter to leave the village to live in the sea, so finally told the spirit son his request could not be granted.

'If I cannot take the beautiful Princess Ko for my bride, I will remove the fish from the sea and place a curse on your drinking water. Your people will face both famine and drought, and many will die.'

Despite the warning, the father would not agree to the marriage. Instead he ordered the spirit son to return to the sea.

Soon there was a great scarcity of food, and the springs ran sour. Streams that had always flowed swift and clean dried up and stagnated. Children cried for food, and the elderly called for a drop of water to quench their thirst. Beaches once abundant with shellfish were soon barren. The tides that flowed over them did not leave behind a single living creature. Unless Princess Ko married the spirit son soon, the members of her tribe would all be dead.

The princess was as kind as she was beautiful. It deeply hurt her to see her people suffer, and when she could bear it no longer, Princess Ko went out into the water. Calling to the spirit son, she begged him to give her tribe food and water.

He replied, 'Tell your father that only when you are my bride will the fish again swarm into the waters. Then your people may live in plenty once more.'

She told her father of this meeting and of what the spirit son had said. Her father then realized that the only way the tribe could be saved was for him to give up his beautiful daughter.

That evening he walked to the beach and looked over the boiling water of Deception Pass. Suddenly the image of the spirit son appeared, giving the father a cold chill.

With a heavy heart he agreed to give his daughter's hand in marriage, but only after making one stipulation. The spirit son was to allow the princess to return to the tribe for a visit once each year so that they could see if she were happy and well. This was agreed upon.

After bidding farewell to her friends and family, the beautiful princess wrapped her wedding garments around her and walked into the water. Farther and farther into the current she waded until only her hair could be seen drifting with the tide.

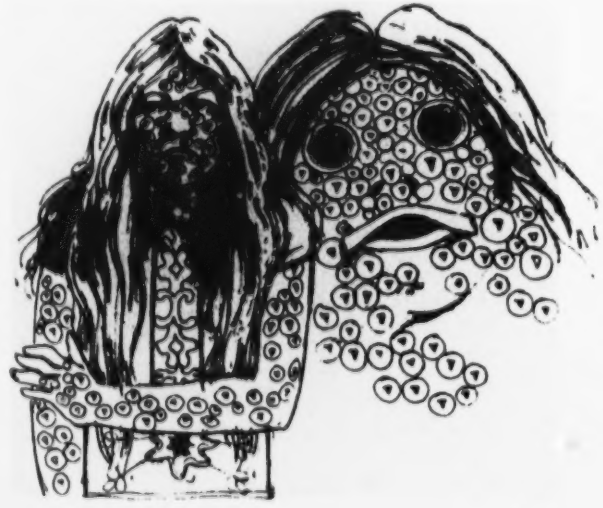
Almost instantly the springs bubbled pure sweet water and the streams flowed clear. The sea teemed with hordes of silvery salmon, and once again the beaches were rich in shellfish. The gifts of the sea returned, bringing prosperity to the tribe.

For four years, Princess Ko visited her people once a year as she had promised. The day before she was to arrive there was always more food than usual. But each time Princess Ko returned to visit her people, the tribe noticed a great change in her. First her hands were covered with barnacles, then her arms, and the last time she came the barnacles covered her face, which once had been so beautiful.

In her presence, people felt chilled as if icy winds were blowing. Her father noticed she seemed to be unhappy out of the sea, so on her fourth visit, he released her from her vow to return to her people each year.

Today, as the currents flow back and forth through Deception Pass, her hair may still be seen drifting with the tide. It is said she will always be there to look out for the welfare of her people.

Early Puget Sound Indian Culture. Pacific Science Center/Sea Grant Project ORCA, Pacific Science Center, Seattle, Washington.

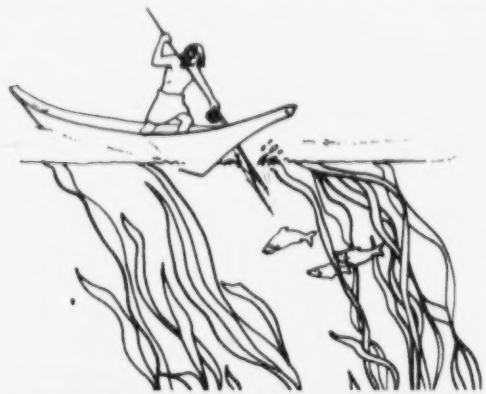


1.1.2 Indian Fishing Technology

There were several different kinds of fishing depending upon the nature of the water in which the fish lived. There were freshwater lakes, freshwater streams and creeks that drained into the various inlets and bays on the Sound and the straits; the water of the shallow bays, basically the tideland flats; the inlets and the sound itself, which were considerably deeper and broader bodies of water than the shallow bays, and the large straits.

Salmon were prized by the Indian fishermen. These were originally captured (1) in nets, (2) in weirs, (3) with hook and line before entering the river, and (4) with spears. The salmon spent an average of three years at sea and returned to their spawning grounds and gravel beds in the freshwater streams in the mountains. In freshwater lakes, the object was to catch the fish before they entered deep waters. The Indians would therefore station themselves at the outlet of the lake and either spear or gaff the salmon. (A gaff is an implement about six feet long with a hook at the end.) The trick was to spear a fish and haul it aboard in one swift, continuous motion.

Harpooning Salmon

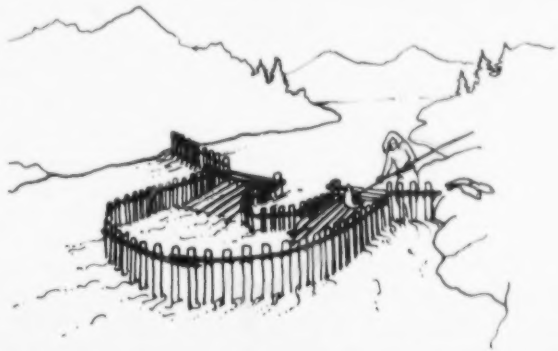


Path is cut through kelp bed on reef for migrating salmon. Fisherman ties up canoe across channel, harpoons fish coming through by the easiest route.

Drawn from *Indian Fishing* with permission from Hillary Stewart.

In fast flowing streams and rivers, a variety of traps were used to catch salmon. One was the grid trap.

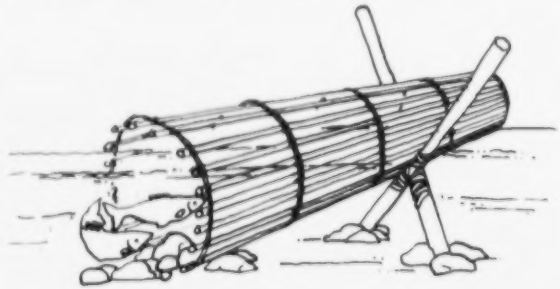
Grid Trap for Swift Water of Coast Salish



In swift water salmon enter through fence opening. Because they can't continue forward they turn to find another way and are swept up onto grid and caught between slats.

Another was a river trap used in shallow, swift water.

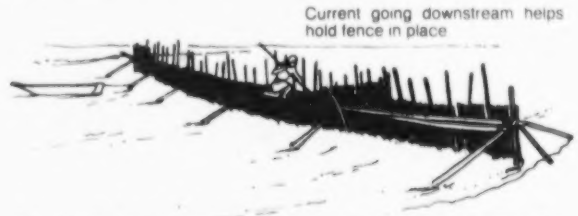
River Trap of the Nootka
(Western Vancouver Island)



Similar traps of slightly different design were used by the Coast Salish. Used in shallow, fast flowing stream. When salmon are migrating upstream, men upstream frighten fish back down river. Strong current drives fish up into trap where they are speared.

The most famous techniques were large weirs, usually community property, built across the rivers to catch the returning salmon. Weirs varied with the width of the stream, but generally they had tall poles stuck firmly in the stream bed to which a fence of stakes was attached. Salmon swam through the fence openings going upstream and were trapped behind the weirs. People used dip-nets to take the salmon and they killed the fish with a club.

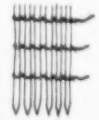
Fence Weir of the Coast Salish



Sections of lattice fence are put up against a frame of tall poles across the river. Openings in the lattice allow fish to enter narrow traps in which they can't turn around.

Types of lattice fencing

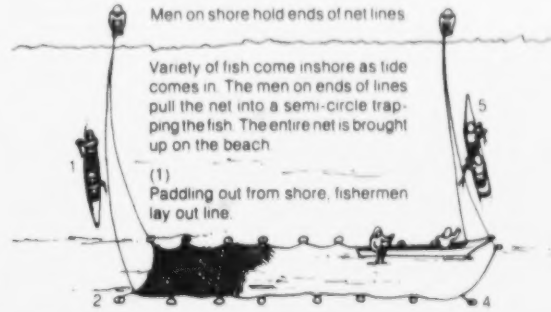
Split cedar sticks lashed with cedar withes.



One and two strand twining with cedar withes.

The beach seine net was also used at high tide.

Beach Seine Net, Coast Salish


Men on shore hold ends of net lines
Variety of fish come inshore as tide comes in. The men on ends of lines pull the net into a semi-circle trapping the fish. The entire net is brought up on the beach.
(1)
Paddling out from shore, fishermen lay out line.
1
2
4
5

(2)
One end of net is anchored with a stone.

(3)
Net is set out as canoe paddles along its length.

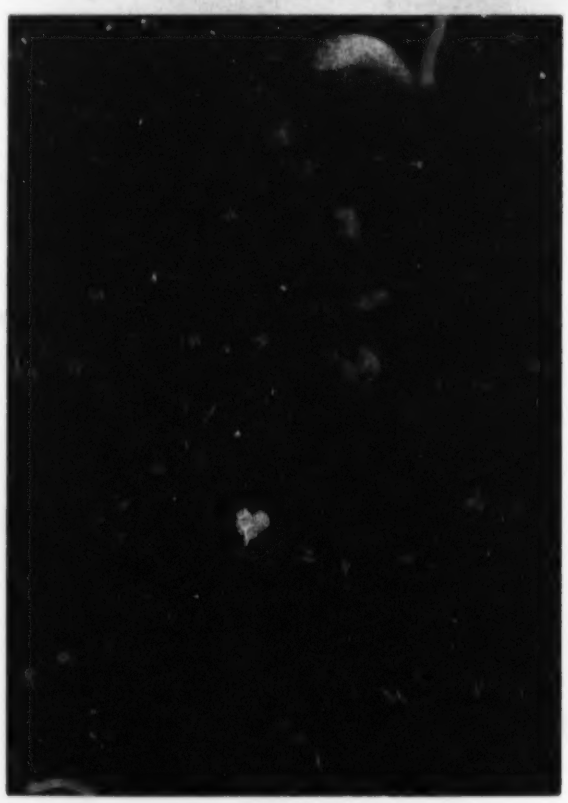
(4)
Another anchor is set.

(5)
Canoe returns to shore laying out lines on other end of net.

The herring were taken in large numbers with fish rakes and nets. The fish rake is paddle-like in shape, set with a row of spikes along the edge. It was swung through a school of fish from a canoe

Herring Raking

Fisherman sweeps herring rake through water in one paddle-like motion, drawing it up and under fish



Above: A totemic carving representing a salmon
Left: Halibut fish hook

1.2 Aboriginal Fishing Culture

1.2.1 North Eastern Arnhem Landers and the Sea

Aboriginal people have inhabited Australia for at least 40 000 years. During this period, they were hunter-gatherers. Because most of them lived on or near the coast, the sea provided a large proportion of their food. It is the Arafura Sea which provides much food for the people of north eastern Arnhem Land. The warm tropical waters contain an amazing variety and quantity of edible animal life - fish, shellfish, dugong, turtle, crab, rock lobster and crocodiles. For many years the Aboriginal people have fished and hunted in the waters of the Arafura Sea and the saltwater tidal rivers and estuaries.

A variety of fish traps and spear fishing used to provide as much food from the sea as was required, but they are not so often used now. Today, some of the large animals - turtle and dugong - are speared with a harpoon. The harpoon for the turtle has barbless prongs and strong rope tied to the end of the shaft. The other end of the rope is tied to the boat. The turtle or dugong swimming on the surface of the water is speared behind the head. When speared, the dugong swims away and often tows the boat too. Turtles swim down to the bottom and stay there. When the animals weaken and tire, they can be pulled to the side of the boat and lifted into it. A similar spear is used for catching crocodiles. The speared crocodile may swim away like a dugong or bury itself in the mud on the bottom. It might take an hour to raise the crocodile.

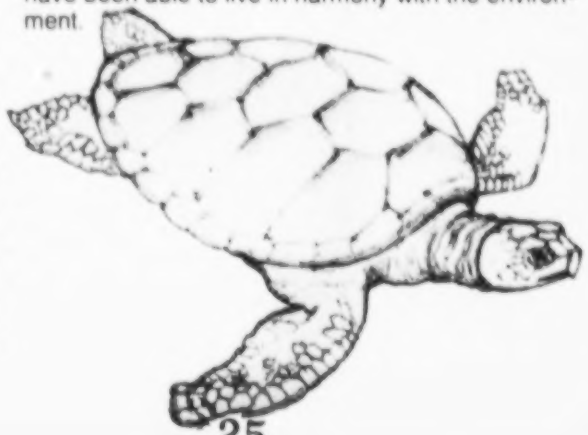
To Arnhem Landers the sea is more than a source of food. It has deep religious significance. But both of these aspects of the sea and its life are intertwined. To understand the Aboriginal perspective of the sea, you must have some understanding of Aboriginal religion. For the Aborigines of north eastern Arnhem Land, use of the sea and its resources are governed by that religion.

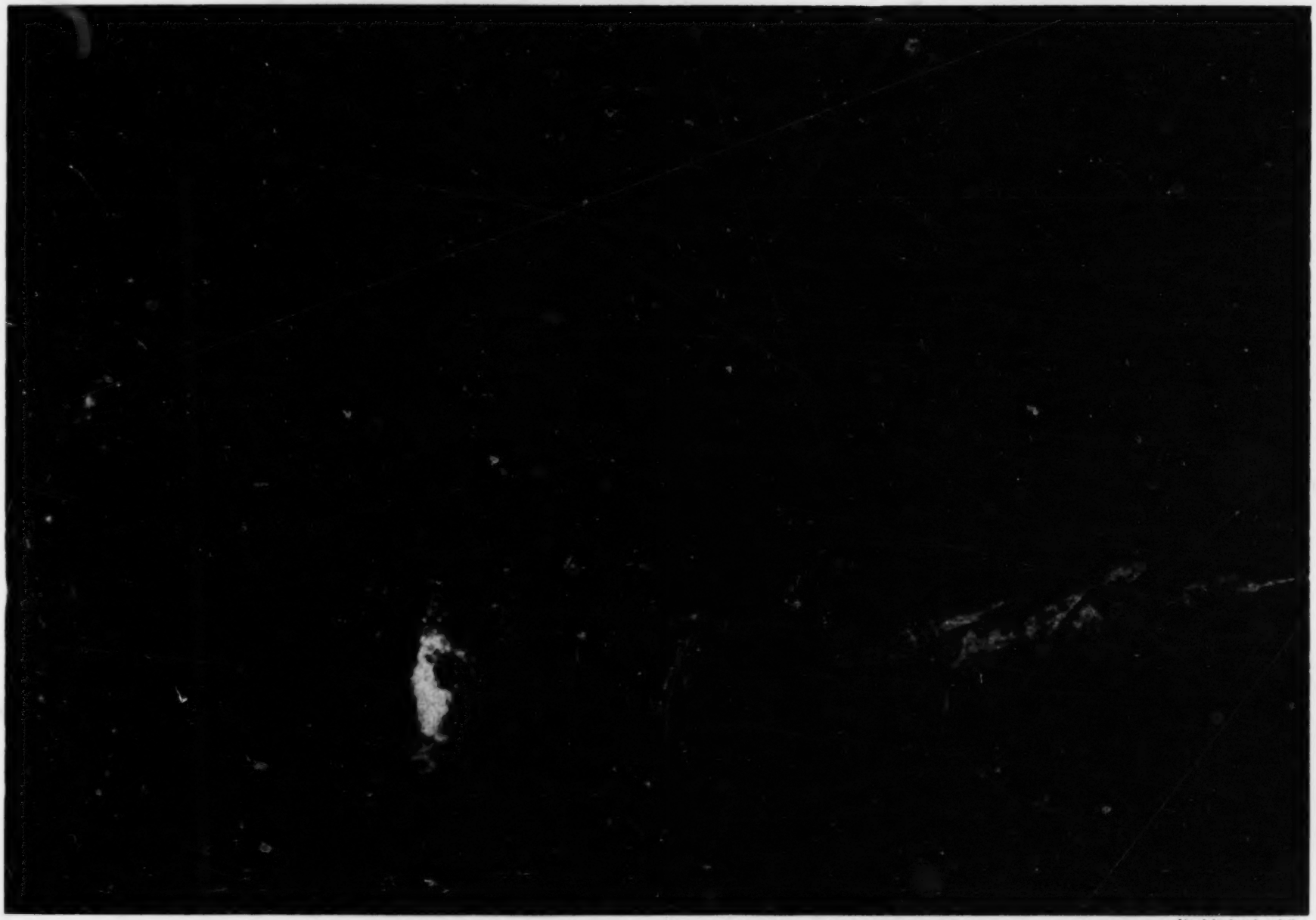
Aboriginal people have deep religious beliefs which affect every part of their lives. These beliefs go back to a time before there were human beings on earth - to a time in the distant past commonly called the Dreamtime by non-Aboriginal people. It was during the Dreamtime that the ancestral beings, by the things they said and did, set a standard for Aboriginal behaviour today. The ancestral beings travelled across Arnhem Land. They created and named the natural features of the area - waterholes, hills, rocks, distinctive trees. The spirits which live in these places give them special sacred importance. They give the land itself sacred significance. The land and sea provide not only food and material needs for the Aboriginal people; they have a special importance as well.

In the past, the animals were able to take the shape and form of human beings and things as well as their own form. Because they associated with the ancestral beings, these animals became sacred. They became totems for the great ceremonies. The ancestral beings are considered eternal, so the Aboriginal people believe that they are still alive today. It is through ceremonies that tell of the past actions of the ancestral beings that their help and power can still be used. The power of the ancestral beings guarantees the continuation of life for people, plants and animals. It guarantees that nature's cycle functions correctly.

How? Because religious beliefs have been translated into hunting laws that have prevented the people from taking too many of one species of animal. Some animals are hunted only at special times. Other animals are held sacred by each clan group and are not hunted at all. For example, totems representing crocodile tail and dugong flippers are sacred, so these parts of the animals can only be eaten by old men of the clans to which the totems belong. Old men of other clans can eat them only if invited by an old man of the owning clan. When hunting the large blue mud crabs, the women are careful to catch only the male crabs believing that this will not interfere with the natural increase of the species. Also, the women hunt for the crabs in a different area each day. In this way, the crab population is not drastically decreased in any area. These simple conservation measures and the modest harvest have kept all animals in good numbers in Arnhem Land until the present day. The Aborigines of Arnhem Land, like those of other areas, have been Australia's best practising conservationists, mainly because they take from the environment only their daily needs. They have had no need to clear land and become farmers, no need to store up supplies. Tribal laws have controlled the kinds of foods and the amount taken.

The Aborigines have successfully fitted in to their environment without causing its destruction because they feel spiritually at one with the environment and they understand it in every detail. They have learned to read signs in nature telling them things that are about to happen. Experience has taught them which time of year is best to hunt certain animals. They move about in groups getting the best out of each habitat at exactly the right time each year. Aboriginal children learn to understand their environment from a very early age by watching their parents on hunting trips, but also through songs, dances, legends, art and games. Success means being in the right place at the right time and the environment gives all the signals to those who understand. Today, when compared with other parts of Australia, Arnhem Land is a wildlife paradise. Here is proof that human beings have been able to live in harmony with the environment.





Aboriginal rock painting

1.3 The Fish Hook

Of all fishing gear, the most familiar is the fish hook.

Over thousands of years people in traditional cultures designed and perfected hooks and their accessories — bait, lures, sinkers, floats and lines —for fish of various sizes, habitats, characteristics and behaviour.

Indian fishing gear was so well suited to their environment and their fishing skill so great, that they saw no need to change when white men sailed into their waters and introduced other kinds of hooks.

In 1885 Albert Niblack wrote in a published report for the U.S. National Museum, 'the apparent clumsy hooks of the Indians have been found to possess so many advantages over types used by Europeans that they are used to this day'. He wistfully added, 'there is little in the art of fishing we can teach these Indians'.

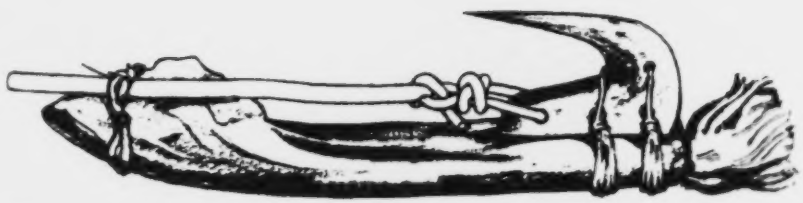
On the contrary, there was much in the art of fishing the natives could have taught the newcomers.

Captain Dixon and his crew, anchored their square rigged ship in a sheltered bay in 1787 and lowered a boat so that the hungry crew could catch fish fast. The results with European gear and methods must have been discouraging.

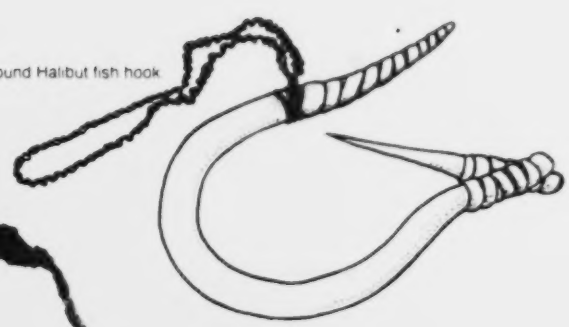
He described the Indian's successful method for catching halibut with baited hooks, lines, and floats and then said: 'Thus we were fairly beat at our own weapons, and the natives constantly bringing us plenty of fish, our boat never set out on this business again'.

Similarly the making of lures is a highly developed skill among the Pacific islanders.

In the 1950s, Australian fishermen used pearl shell lures from the Gilbert Islands for pole-fishing tuna. These are extremely successful at attracting fish and convenient to use because there is no need for live bait and the catching and carrying of tanks of live fish.



This is one of the Gilbert Island pearl-shell lures. It is a little over 100mm (4 in) long. The hook has been fashioned out of aluminium (from a downed World War II aircraft) and the tail is made out of yellow synthetic material.



Puget Sound Halibut fish hook.

Shark hook from Tahiti, with wooden shank and pearl-shell hook 185mm (7¼ in) long.

Basalt stone hook from Easter Island 90mm (3½ in) long.

1.4 Changing Traditions in the Solomon Islands

If you were a Solomon Islander would you be living today as your father and grandfather did?

It depends of course on how much **change** has taken place in your lifetime.

You will recall from p.9 at the beginning of the book that a **traditional** society is one where there has usually been a very **slow rate** of change.

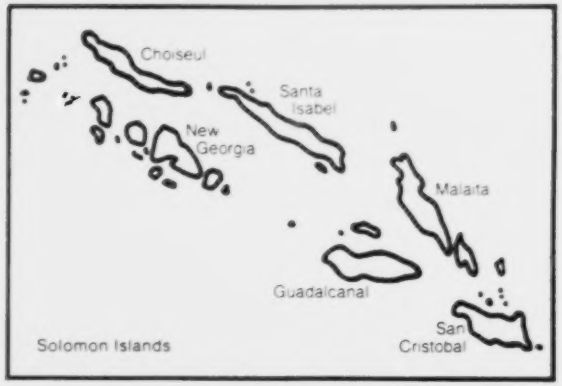
Until recently the Islanders were **subsistence** fishermen. Can you remember what that means?

The building of roads and new methods of transport are beginning to change this and other traditional practices. This section looks at ways in which modern technology can bring about change in a traditional society.

The Islands

Solomon Islands is a country in the western Pacific region, independent since 1978.

It has six main islands — Guadalcanal, Malaita, Choiseul, Santa Isabel, New Georgia and San Cristobal — and many smaller ones.



As most of the islands in the Solomons have been built up by volcanoes, there are very steep and rugged mountains on many of the islands, especially the larger ones. Volcanic soils are very fertile, and with the high rainfall and hot climate, dense bush and tropical forests cover much of the country.

Most people live near the coast. Before contact with Europeans, Solomon Islanders moved around either on foot or by canoe. Because travelling was not easy, many quite separate communities developed over time. Today there are over sixty different languages spoken in the Solomon Islands.

The People

Most of the 200 000 people in the Solomon Islands are Melanesian.

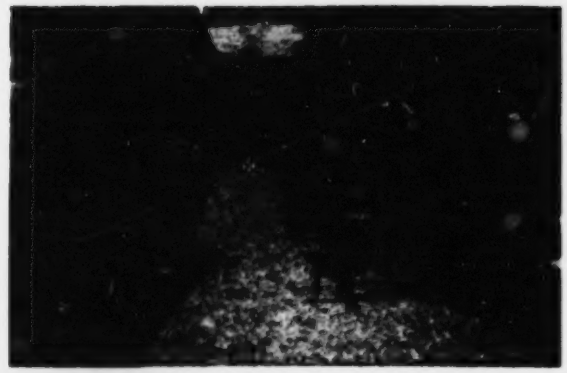
It is thought that the Melanesian people moved to the Solomons from the mainland of Asia many thousands of years ago. Some Polynesians, Micronesians, Europeans and Chinese also live in the Islands.

In the sixteenth century the Spaniards were the first Europeans to make contact with the Islands. They approached the islands from South America but because European navigation was not very accurate at the time, they lost contact with the islands. About 200 years later the British made contact — mainly through missionaries and traders. They came to dominate the islands and from the early 1890s until 1978 the Solomon Islands were a British protectorate.

This was the first time that the area we now call the Solomon Islands was under the one government. English is now the official language of the islands, although only approximately 15% of the population speaks English. Most people speak pidgin — a language made up of a mixture of English words and words from the local languages.

About 80% of the people of the islands live in villages. These villages might have as few as 10 people or as many as 2 000. Villagers in the rural areas have traditionally provided most of their own needs from their local environment through activities such as hunting, fishing and gardening.

Not many people live in the towns which have grown only since contact with the Europeans. The biggest town is the capital Honiara (on the island of Guadalcanal) with a population of approximately 20 000 people.



1.4.1 Coastal Environment

Coral reefs form barriers around much of the coastline of the islands.

Coral reefs are built mainly by **coral polyps** — small animals living together in colonies which take calcium carbonate from the sea water, and build it into their own bodies. There are many different forms of coral. Common ones are: brain coral, mushroom coral, organ pipe coral, branching staghorn coral. The names indicate the great variety of shapes and forms. When alive, corals come in a great variety of colours. When dead, all that remains are the hard white calcareous skeletons, familiar to many collectors.

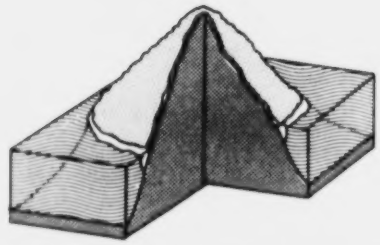
The coral skeletons, however, are only one element in most reefs. Very small plants (algae) grow in the coral and in the surrounding water.

Reefs grow only in certain conditions. Coral grows best in clear warm water, and the algae need enough sunlight to make their food through photosynthesis. As sunlight only reaches into the top layer of the ocean, reef-building corals rarely grow in water deeper than 25 fathoms (50 metres). Corals can be killed by many things — cyclones; flooding from nearby mainland areas which dilutes the salt water too much for the corals; too much silt for the corals to be able to remove it; changes in water temperature; and predators, such as the crown of thorns starfish. Coral does not grow well in cloudy water, so a coral reef which might stretch for many miles around a coast will often stop at a muddy river mouth. These breaks are useful entrances for boats into lagoons between the reef and the coast.

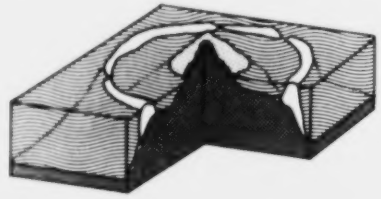
Types of Reefs

There are three types of coral reefs.

1. **Fringing reefs** grow right alongside the coast, often separated from the shore only at high tide. These reefs are found around 'young' islands, ones that have been formed 'recently' in terms of the age of the world. Fringing reefs are found in the Solomon Islands and in Hawaii.

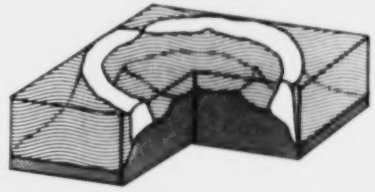


2. If these fringing reefs continue to develop and the island is eroded, a **barrier reef** is formed.



Far from shore, this outer reef protects reef flats and a large shallow **lagoon.**

3. Finally, over a great period of time, the island will be eroded and sink completely below the surface leaving only the coral reef, now called an **atoll**. Many atolls dot the Pacific Ocean.



Coral atolls are flat and only a little higher than the level of the sea. The coral breaks down to form a sandy whitish soil, and palm trees are often among the first plants to grow on these islands.

Many atolls are big enough for people to live on. Busu village (p. 21) is a coral atoll.

Lagoons

Coral reefs grow from the ocean floor to the surface of the ocean. This means that the ocean waves break onto the coral reefs and not onto the seashore. Between the coral reef and the shore is a **lagoon**, which is usually calm and still. As lagoons are shallow, sunlight reaches to much of the lagoon floor. Plants can photosynthesise in most of the lagoon waters. Lagoons are able to support a rich variety of marine plants and animals. Most traditional groups in the Solomon Islands have found lagoon plants and animals provide most of their needs for sea food, and do not need to depend on deep sea fishing for their day to day needs.

Fairly **light canoes** are all that is needed for paddling in the lagoon waters. Ocean going canoes need to be heavier because they have to be able to cope with ocean waves and storms. Ocean trips are regarded as hazardous. As lagoon areas often extend many miles along a coast, ocean voyages are relatively rare, and only necessary for inter-island trips.

Tropical waters look so clear and blue because they are relatively poor in nutrients and thus support little plankton — in fact they are a virtual oceanic desert! (Temperate and polar waters are not so clear because they have a much greater presence of plankton.) Although tropical waters have so little nutrient, the surprising thing is that coral reef environments are amongst the richest environments for sea life. In the Great Barrier Reef off the northeast coast of Australia, for example, you can find examples of one in every ten sorts of fish in the world! People think that over many years reef organisms have trapped any nutrients available to them from the ocean waters, and built up a store which the shallow enclosed area of the reefs did not allow to be washed away again. Rapid recycling of energy within the system has allowed a great variety of life to be found there.

A coral reef is an example of an **eco-system** — a group of plants and animals which are interdependent and within which energy is recycled by animals and plants feeding on each other.

1.4.2 The Lau People of Sulufou

The Lau people live on the north coast of the island of Malaita, in the area known as Lau.

The Lau people used to live inland but they moved to the coast. About a thousand years ago they built artificial islands out in the lagoons so that they would be within easy reach of the reefs around the lagoons which harboured a rich variety of seafood.

The artificial islands had the added advantage of protecting them from enemies living inland.

To make artificial islands the Lau people collected stones — mostly coral — and loaded them into canoes or rafts. They took the coral stones to shallow parts of the lagoon and piled them up until they were above sea level. To make even a small artificial island took a year or more. Most of these islands are big enough for only one family but the larger ones have substantial populations. The largest, Sulufou, has a thousand inhabitants.

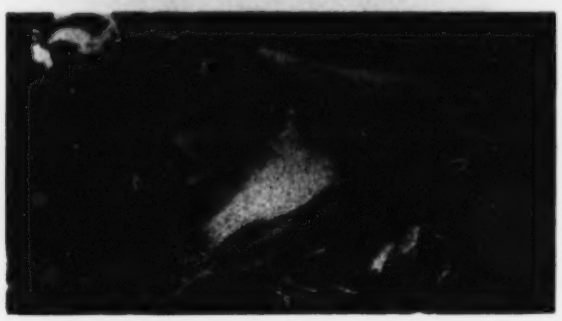
As well, the Lau people have land on the mainland from which they get the material to build their houses.

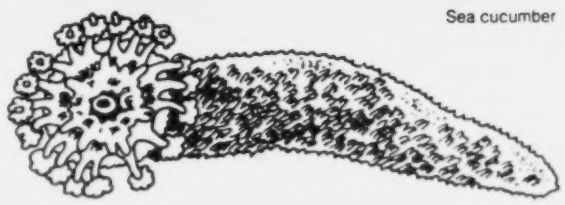
They are known locally as Salt Water People because they eat so much seafood.

Like many other coastal communities in the Pacific islands they depend on seafood from the coastal reef area for much of their food. They eat fish and shellfish of all kinds and *beche de mer* (sea cucumbers). The reefs provide such a rich variety of seafood that they do not need to fish regularly in the deep ocean area outside the reef.

For the Lau people collecting food from reef areas has traditionally been a **subsistence** activity — they collect enough for their own needs, to cook and eat and to barter at the local market for yams, taro and sweet potato. Selling fish in an organised way (a **commercial** activity) has come only recently to Sulufou.

Now that outboard motors are available some Lau are moving to the mainland and abandoning their artificial islands. They can now get from shore to reef quickly which means they can tend their own gardens as well as fish. They can also make use of the new road from Auki which reached their area in 1972.





Sea cucumber

Since the building of the **road from Auki**, a very great change has come over the lifestyles of the fishermen of Sulufou.

Instead of fishing just for their own needs and to sell at local markets, the village fishermen trade in Auki which is only five hours away on the road.

A large part of the catch is weighed in the village and put into eskies (cooling bins) — together with ice brought from Auki. These eskies are taken by boat to the mainland and then loaded onto a truck to be taken by road to Auki.

Every esky brings $30 (1978 prices) into the village and the villagers can fill three eskies a week.

This extra $90 has made a big difference to the life of the village. There is now a sizeable store in the village which sells tinned goods, fishing lines and hooks, all pharmaceuticals, stationery, cloth and clothing.

The whole enterprise has been made possible because the village was able to buy a truck with financial help from a bank in Honiara.

The **market at Takwa** is typical of the many places where the Lau people come to trade.

Every Saturday afternoon they bring their fish and other products by canoe to the nearby Takwa mission. The hill people come down to the coast with their garden produce.

Most goods at the market are exchanged by bartering. Before trading at the market begins, there is time to meet friends and exchange news. The market is more than just trading goods and is carefully organised. The area constable makes any general announcements and reads the council regulations about the trading. No-one can begin to barter until the constable gives the signal — the fine for breaking the rules is $10.

European money is now being used at Takwa as the village people are getting more cash from selling their produce at the larger market in Auki. The council has issued licences to hawkers who come and sell special goods that are in short supply or may not be sold in the local village stores. In addition to the traditional foodstuffs of the market, people can buy some European goods such as ball point pens.

20

Collecting romo

1.4.3 Shell Money:
Malaita, Solomon Islands.

Shell money is the traditional form of exchange in most parts of the Solomon Islands.

Originally its uses were very similar to European money. People who had a lot of it were wealthy. Land, goods and food could all be bought with it.

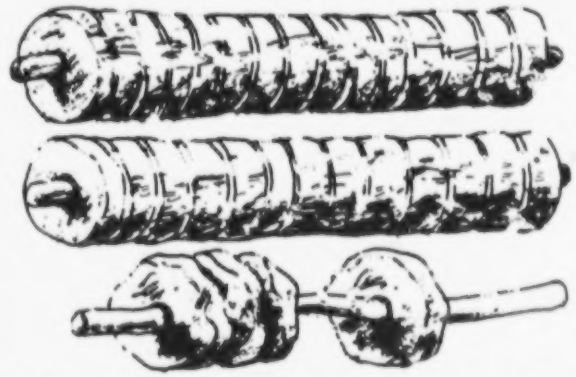
It was also used ceremonially — to make reparation (compensation) for a death; to honour an individual; to pay for feasts of all kinds and to buy a bride.

In most parts of the Solomon Islands, a girl was only given in marriage when her family received an amount of shell money equivalent to its status — as few as two strings of red shell money or as many as 500 were necessary depending on the importance of the family.

In return the family would bring to the marriage feast pigs and other foods, almost equal in value to the shell money it had received.

Most of the shell money is made in Langa Langa on the island of Malaita.

A string of shell money is made from small pieces of shell which are drilled and put onto strings of different lengths. The shells are then polished with stones until the pieces are circular. The shinier and finer the shell money, the greater its value. Strings of about 2 metres are fairly common.



A number of different shells can be used for making shell money but **romo** is one of the best. Romo has a clear red colour. It's a **mollusc** which grows on the coral reefs of the lagoon. In summer, when the seas are calm, most of the men from the village go out together to collect romo. Sometimes they all share the money they earn from collecting the romo. Occasionally they all go to collect to help someone who is getting married and needs a bride price. They know that they will be helped in the same way by the community when they need help.

They might dive in an area for a couple of weeks. A priest will usually go with them to bless the waters to make them safe from sharks which are common in the waters of the Solomon Islands. Between 15 and 20 canoes might go, each with a couple of men in them. Canoes are made from hollowed logs and the men have wooden paddles. Some of the men wear rubber goggles — a fairly recent introduction — showing that some European goods are common even in this remote part of the islands. Apart from the goggles, the men have no special diving equipment. They must hold their breath for long periods as they dive to the floor of the lagoon, and collect the romo by hand. They put shells they collect in the bottom of their canoes. At the end of the day, the boats return to shore and the men carry the shells up to the village in large baskets made of dried palm leaf.

While the men have been collecting the romo, the village women have been preparing the oven to cook them in. The 'oven' consists of a large pile of stones which have been heated in a fire. The romo are placed on top of the hot stones, then palm leaves placed over them. The women then sprinkle water over the top to produce a lot of steam, to steam cook the romo. On the first evening of collecting romo, only the men eat, although the women join them on the other evenings.

After eating the romo, the shells are kept, carefully washed and then laid out on bamboo mats to dry in the sun. After they are dry, they are stored until they are taken to Langa Langa.

As it is quite some distance to Langa Langa, and part of the journey is outside the reef, ocean-going canoes are used. This is a hazardous journey, and a priest usually blesses the canoes to ensure a safe trip.

There are a number of villages in the **Langa Langa** lagoon where shell money is made. One of these is **Busu village.** Busu village is not on the mainland — it is built on a coral island on the reef.

People in the villages of Langa Langa no longer make shell money in the traditional way — they have found that by using some European tools their job is both faster and easier. Many of their traditional tools are now fetching high prices in museums in different parts of the world. One man in Busu village, however, has recognised the tourist value of traditional shell money making. When the tourist boat comes to Busu village once a month, he organises the people of the village to put on custom dress and to re-enact the traditional way of making shell money in a leaf house built specially for the purpose. In between these visits, people make shell money at their homes.

Traditionally people on the Langa Langa lagoon used to fish and garden like the other people in the Solomon Islands, and they made shell money as well. However, over the last 20 years making shell money has become so profitable that they now do very little fishing and gardening. This has happened because shell money has become a tourist industry — tourists come to watch it being made and they also buy it. Tourists pay more for shell money than locals. As a result shell money is playing a new role in the Solomon Islands.

The Sea of Change

Francis Bugotu

Voyagers!
The Canoe has been launched,
The paddles are pounding at the sea,
Almost in unison but not quite
You are the paddlers, get in tune,
So that we will arrive in time.

The sea is rough,
The waves come in many shapes and sizes.
Dip your paddles further and calm the waves
Do not pull them from the waters.

In the canoe,
Lie coconuts and shells
Arrange and sort them,
So they may be presentable to others
Only then may you stretch your legs.

But paddlers, do not sleep,
Or the canoe will drift.
Be vigilant o'er sea and waves
At every stage,
Should chance permit
Pick up young coconuts and shells along the way.

Above all, the faithful steersman
A Solomon Islander he will be
A guide who feels from the elements
The direction he must follow.

2.0 Fishing in Industrialised Societies

2.1 The Japanese Tuna Fleet

The Japanese tuna fleet is one of the world's biggest and most technologically advanced distant-water fleets.

Why have the Japanese developed such a large fishing fleet and why do they travel further from their home territory in search of fish than most other fishermen in the world?

One of the main reasons is that historically Japan has had a high population in a relatively small country. There has been limited land available for grazing animals for meat, unlike the vast ranges of North America and Australia. It has been estimated that if Japan replaced one half of the protein it presently gets from fishery products with an equivalent amount of meat, it would need pasture lands and breeding areas for livestock equal in size to the total Japanese land area. Unlike the North Americans and Australians, the Japanese are not big beef-consumers. Their main source of protein — the essential nutrient for building body tissue — is fish. The average North American eats only about one-seventh of the fish consumed by the average Japanese. It comes as a surprise to most of us to learn that the amount of protein in an average serving of fish is equal to, and often higher than, that in an average serving of beef.

The need for the Japanese to harvest large quantities of fish means that their boats have to be capable of fishing in all seas of the world and they use technically advanced equipment to locate the fish, to catch it and to store it.

Compare this with the people of the Solomon Islands in the Western Pacific.

2.1.1 Tuna Hunt — A Worldwide Oceanic Fishery

The tuna are a family of fish which occur in all the warmer oceans of the world as well as some of the cooler areas.

Tuna are **pelagic** fish — they live near the surface of open ocean waters and are not dependent on land areas for different stages of their life cycle.

Many tuna live in **schools** (large groups) but some school only as young fish and then swim alone as adults. They are very fast swimming fish and eat smaller fish which live near the ocean surface. Thus in the ocean food web, tuna are **consumers.**

Tuna are highly migratory fish. Tagging studies have shown individuals have moved many thousands of miles. But their migrations are not random — they follow patterns which can be related to different stages of their life cycle.

The species of tuna which are most important commercially are:

Bluefin	Bigeye	Albacore
Southern Bluefin	Skipjack	
Yellowfin	Bonito	

Tuna are caught principally for human consumption and are sold fresh, frozen, canned, smoked and dried. The flesh of different species of tuna has differing characteristics, for example bluefin, southern bluefin and bigeye are sought after by the Japanese for eating raw (*sashimi*). Albacore has a white flesh when caught and is highly prized for canning in the USA. In contrast Australia cans southern bluefin. Skipjack is a small species with dark soft flesh and is therefore the least valuable. It is the major canning species.

Because of their abundance and wide distribution, species of tuna have been caught and used for centuries by people of many different cultures of the world.

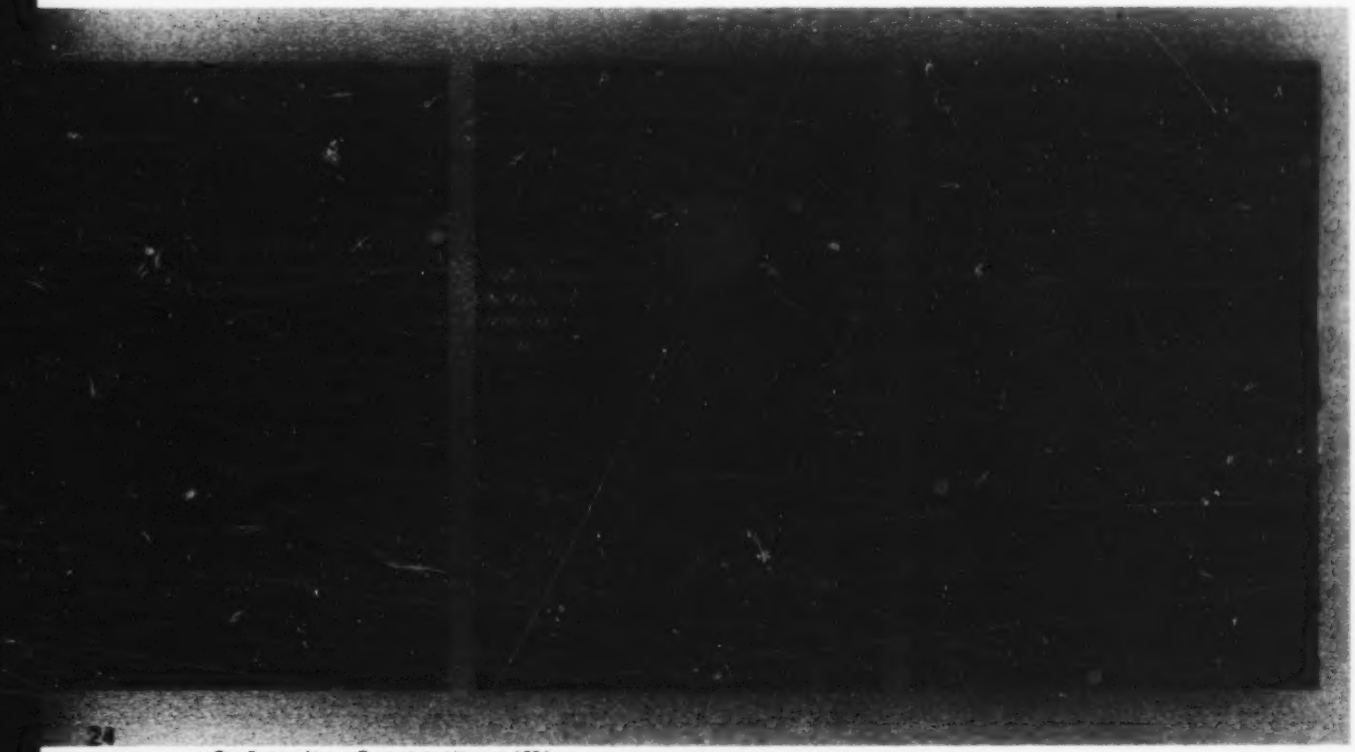
2.1.2 Ancient Tuna Fishing

The Japanese have been catching tuna since the late Stone Age. The earliest known reference to tuna is found in a chronicle compiled in A.D. 712. An ancient song tells of schools of tuna migrating close inshore and fishermen harpooning them in shallow water. Harpoons made from animal bones have been found, as well as stone weights that suggest ancient fishermen may have used plant fibre nets.

Raw food has always been popular in Japan. However tuna itself has not always been so popular. In the 1600s the taste of tuna was considered so bad that not even the poor would touch it. Up to the mid-years of the Taisho Era (1912-26) fish dealers would give this fatty meat to any taker. There was just no market for it. However demand for the product gradually grew and it has become a favourite Japanese delicacy. Today fatty tuna belly-meat has become synonymous with caviar and is generally the preserve of 'expense-account aristocrats'.

But how important are tuna fisheries in Japan? Of the approximately 10 million tonnes of fish produced by Japan, tuna makes up only some 300 000 tonnes. But it commands the highest prices of any fish product in Japan.

Anyone in Japan who has eaten 'toro' at an exclusive Ginza restaurant lately probably paid about 1000 yen around $A4.00 for one bite-size slice. The name 'toro' was used to describe the belly meat because it literally appeared to melt on your tongue (*torotto suru*).



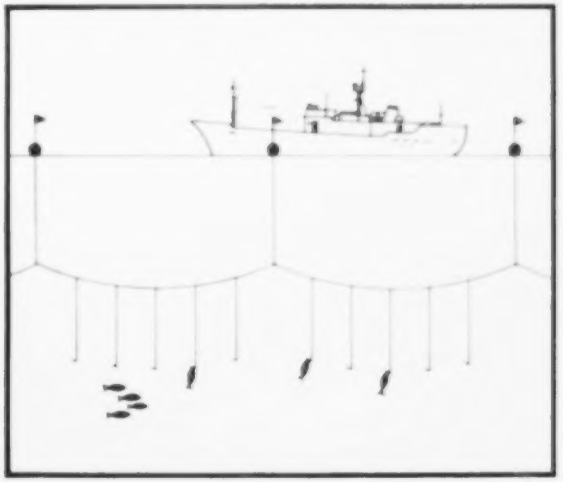
The Fishing Net — Triptych by Utimaro, 1804

2.1.3 Today's Tuna Fishery

Tuna in general are referred to as 'maguro' by the Japanese, a name derived from the term 'meguro' or 'black eyes'. Some of the most valuable species landed in Japan are the bluefin, southern bluefin, bigeye and yellowfin.

The vessels that make up most of the distant-water *sashimi* fleets are called 'longliners'.

Longlining



Longlining is the most effective way of catching solitary tuna in oceanic waters. Longlining is just what it says — using long lines to catch fish — and some of the long lines can be as long as 125 kilometres! The long line has many branch lines on it, each of which might be about 40 metres long, and have a baited hook. These branch lines are clipped on a sufficient distance apart so that a fish caught on one line will not get tangled with other lines while it is swimming around trying to escape. Tuna are caught by longlining in different parts of the Pacific, Indian and Atlantic Oceans. Longlining is almost a 24 hour operation. By the time the line is hauled, it is almost time to bait and set it again.

2.1.4 The Keifuku Maru

The *Keifuku Maru* is in many ways a typical Japanese longline tuna vessel. It is about 40 metres long and carries a crew of around 20 men.

Selecting fishing grounds and directing fishing operations is the responsibility of the fishing master. Once he would have scooped some water and tasted it or even 'smelt it for the tuna's presence'. These days, however, he is assisted by modern equipment such as electronic **thermographs** (which automatically register any changes in water temperature), radar and fish finders. Satellite weather pictures are used to indicate sea temperatures. Charts showing fishing and environmental conditions in various areas are also consulted.

In Japan **crew members** are hired only for one fishing trip at a time. Good crews are not easy to find. The crew work long hours, the work is hard, their quarters are usually cramped, and they are away from their home port and their families for periods from 6 to 18 months at a time.

Each fishing day the crew have to set the longline and bring it back again with their catch — and there is over 100 kilometres of main line! The crew aim to set the line to correspond with the daylight feeding hours of the tuna, so they begin setting it between 1 am and 4 am. It takes the men several hours to set the line, because there are over 2000 hooks to bait and put into the sea. The main line is broken up into 400 sections called 'baskets'. A buoy is attached between each section to prevent the whole line sinking to the ocean floor.

Between the buoys, the line loops down into the ocean waters, and has hooks hanging from removable short branch lines. (The depth of the deepest hook between each pair of buoys can vary between 50 and 100 metres.)

The longlines use vast quantities of bait, usually mackerel, squid and plastic squid.

When the line is set, it is 'left to soak' for another four and a half hours. About 10 am or 11 am, the vessel steams back along the line and it is taken on board with the catch. This takes about 10 to 11 hours, depending on the size of the catch. Hauling starts

The *Keifuku Maru*

from the end of the line they set, working back to the beginning. This means it finishes around midnight.

Although the *Keifuku Maru* catches mainly yellowfin and bigeye tuna, the hooks also catch a number of other fish that might be swimming past, such as sharks, swordfish and marlin. Only a small number of hooks set actually catch fish — of the 2000 hooks set, only 100 might catch fish in any one day. Not all the fish which are caught can be used, because some have been mauled by sharks after they have been caught on the hook. About one fifth of the fish are lost in this way.

As soon as the whole tuna are hauled on board, they are bled, gilled and gutted. To maintain the high quality of the fish they are quickly frozen to -60° C and held at this temperature throughout the voyage to port. (How does this compare with the temperature of a domestic refrigerator?)

When the holds are full, and the *Keifuku Maru* is returning to Japan, the boat owner directs it to the best potential market. At the market the catch is unloaded and the fish are arranged on the selling floor according to size and species. Auctioneers and middlemen examine the fish before the auction. They are interested in the body shape, colour, quality and degree of belly fat on the fish. Fish which are not suitable for *sashimi* (a raw fish dish) are sold to a cannery, and are placed in a separate area. Auctioning the catch takes about one hour.

2.1.5 The Future

Problems for the Japanese fishing industry
Although Japan is the world's leading producer of fishery products, the industry is facing a number of difficulties at the present. During the 1970s the cost of fuel rose so quickly that it is now a major expense for fishermen, especially those who have been fishing in waters distant from Japan.

Other factors are:

- consciousness of pollution, especially heavy metal pollution, caused a decrease in the consumption of fish and the need to fish farther from shore;
- more distant fishing and the need to negotiate contracts within 200 nautical mile limits raises costs;
- the traditional Japanese diet is changing and people are eating less fish;
- overfishing has depleted stocks in some areas.

Competition from Other Countries
Other countries are also building up big tuna fishing fleets, which are providing competition for the Japanese. Australia, Korea, Taiwan and United States tuna fisheries have substantial numbers of ocean-going fleets.

Australia has about 70 specialist tuna vessels fishing in south eastern Australia. These are, on average, about 25 metres long. Most fish are located for them by spotting aircraft. A similar fleet, less well equipped, fishes from Albany and Esperance in Western Australia.

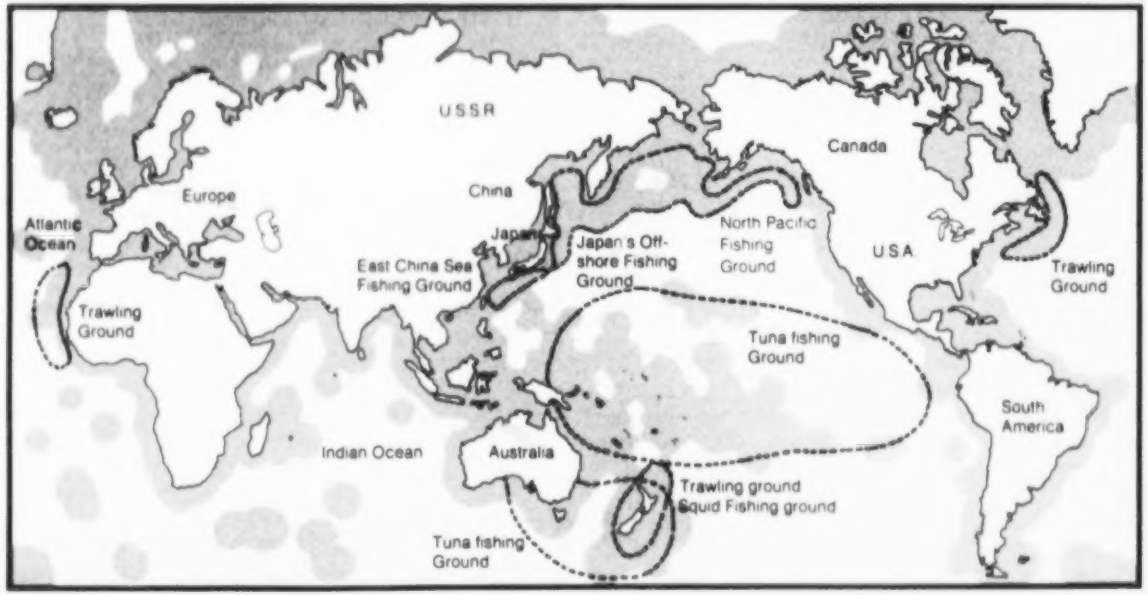
The best known **American** tuna vessels are the very large super seiners (85 metres long) which range all over the Pacific Ocean and may carry up to 1200 tonnes of tuna. Often, they carry a helicopter for fish spotting. One major company operates 53 such vessels and expects to catch 250 000 tonnes of tuna annually. These vessels are worth several million dollars and it is now common for Australian vessels to cost over a million dollars to build.

While the large American vessels use **purse seines**, the Australian vessels are **poling boats** and use small live fish as bait.

Legal restrictions
During the 1970s, many coastal countries in the Pacific Basin declared **200 nautical mile economic zones** along their coast. This followed decisions taken at meetings of the United Nations Law of the Sea Conference. Although tuna are highly migratory fish, the Japanese have often caught them within waters less than 200 nautical miles from land. In order to continue doing this, the Japanese must work out arrangements with different countries involved. For example, in each year since 1979 there has been a progressive reduction in the extent of access by Japanese longliners to Australia's 200 mile fishing zone.

For a full discussion of the Law of the Sea Conference see Book 3, *Using the Sea Wisely*, Section 2.0 'A New World Order: The Law of the Sea'.

200 Mile Nautical Zones in the World and Japan's Fishing Grounds



Notes:
(1) According to 1976 Economic White Paper
(2) 200 nautical mile zone
(3) Waters surrounded by dots: Fishing Grounds, where Japanese fishing boats fish.

Source:
Ino Ryuichi, *Shokuryo Kiki wa Kuruka?* (Is a food crisis coming?)

Ampo, Vol. 10 (4), 1978, p.9.

Tuna Farming
In an effort to overcome some of the problems with the tuna industry, researchers have been trying to rear tuna in captivity in the waters around Japan. In one area, juvenile bluefin tuna about 20 centimetres long were caught in coastal waters, and reared in enclosures, with the aim of eventually producing marketable-size fish. There have been a number of early problems with these experiments, such as high death rates amongst the fish, but the longer term prospects look better. These fish need seven times their body weight in food, such as mackerel, bigeye, scad and sardines. This seems wasteful — it seems better for people to consume the mackerel, bigeye, scad and sardines than to have them fed to the cultured tuna. However, there are enough Japanese with a fondness for *toro* for it to seem worth continuing the attempt to culture successfully the bluefin tuna.

Purse seining

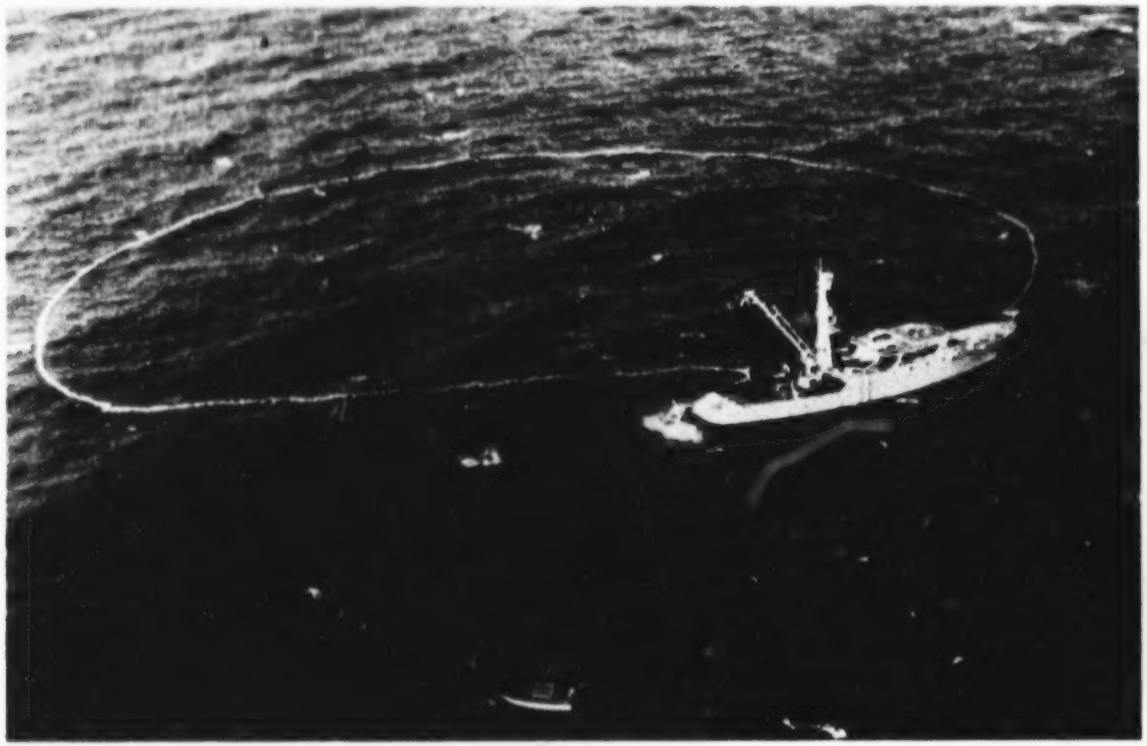
2.1.6 *Frontier* at Work off Eastern Australia

In fishing operations a helicopter is launched from the wheelhouse roof and then searches in a box pattern. When a shot is commenced the skiff is dropped off the stern ramp and holds the bunt end while *Frontier* steams away to encircle the fish with the net. Schools of skipjack tuna are most easily sighted when they ripple the surface. After directing net setting and pursing by radio from the helicopter, the skipper returns to the vessel to supervise the rest of the operation from the upper deck.

To close the net under the fish, the purse rings are drawn together and lifted aboard and stacked on the ring stripper. The wing end of the net is then hauled through the power block and restacked on the back deck, until the tuna are concentrated in the bunt section of the net alongside the vessel. At this stage the net is drawn over the bulwarks, with even tension on all the meshes to prevent the net being torn and the fish lost, until the fish are packed tight enough to begin brailing with a winch-powered, hand-directed scoop net.

The tuna are lifted over the bulwarks and released into a stainless steel hopper which takes fish via under-deck chutes into brine freezing tanks.

During unloading, fish can be sent from one tank to another by chutes, before being lifted out by cargo nets and, during the Eden operations, trucked in cages to the nearby cannery.



2.2 Australian Prawning

In Australia, seafood is not an important part of most people's diet, except in local areas where it is caught and even there consumption per head does not compare with Japan or the Pacific Islands. As a result Australia's fishing industry is much less developed and concentrated on local waters. This section highlights the experience of the Burts of Maclean, a prawn fishing family off the coast of New South Wales.

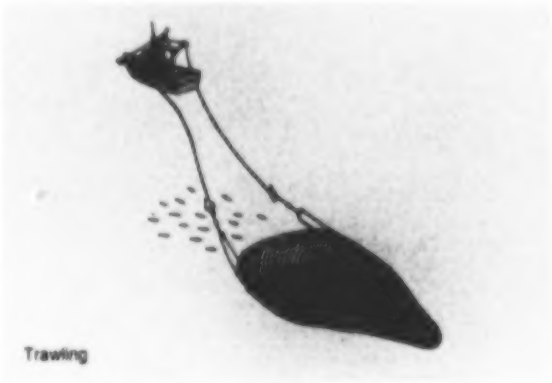
2.2.1 The Burts of Maclean

Tom Burt lives in Maclean, a small fishing town in Australia on the north coast of the state of New South Wales. Maclean is on the estuary of the Clarence River, and Tom belongs to the Clarence River Fishermen's Co-operative. Tom owns the *Silver Moon*, a 15 metre fishing trawler. In the trade, the *Silver Moon* is called a 'wet boat', because it has a large storage tank on board which can be filled with brine (very salty water), and chilled to keep fish fresh if the boat stays out of port for a few days at a time. These days, Tom hires Bill Walsh as a deck hand to help him on his fishing trips. Tom used to own the *Silver Moon* jointly with his cousin Peter, and the two of them ran it together. But Peter left Maclean last year to work in the Gulf of Carpentaria on one of the new big freezer prawn vessels there. Tom bought Peter's share of the boat when he left.

Fishing has always been central to the life of the family. Over the last year Tom's children, Steve and Norma, have been doing more things to help Tom with running the boat. Today they will be putting the *Silver Moon* onto the slip (winching her out of the water) so they can scrape the hull of the boat clean of the barnacles, seaweed and other things which grow on it when it's in the water. Regular cleaning helps keep the boat in good order, and helps it move faster through the water.

Tom's wife Judy often helps with the boat as well, but at the moment she is working all day at one of the factories run by the Fishermen's Co-operative. This is the busy season for the Co-op (December to June) when the local fishermen are bringing in their biggest catches, and the Co-op needs more workers to help with the sorting and processing of the catches. For the last five years Judy has worked there seasonally for four or five months a year. She doesn't see a lot of Tom while she is working, because she works during the day, and Tom works at night during the prawn season.

Still, the Co-operative needs extra hands during the busy time, and the family needs the extra money to help pay off the loan on the *Silver Moon*. And Judy finds she likes working again after spending a few years at home full time when Steve and Norma were small.



Trawling

2.2.2 Catching Prawns on the *Silver Moon*

A lot of prawns are caught near Maclean — in fact Maclean is the biggest prawning port in northern New South Wales. Depending on the season Tom Burt might catch **king prawns**, which come fairly close in to shore, or might catch **royal red prawns**, which live in deep water further out near the edge of the continental shelf. If he is catching king prawns, he usually comes back into port after a night's trawling. If he is catching the royal red prawns, he will usually stay out of port for 2 or 3 days at a time. Tom's trawler can store up to 3 days' supply of fuel at a time, and the prawns can be stored in the brine tanks for 3 days without beginning to deteriorate.

During the day the king prawns stay half buried in the sand or mud on the sea bottom, so Tom tries to start fishing at about sunset when the prawns begin to swim about to feed. King prawns, like most other types of prawns, live together in large groups, called schools. This means that when Tom finds a school, he catches quite a lot of prawns at the same time. Tom sometimes uses **radar equipment** to help find his favorite fishing ground.

Tom uses an otter trawl net to catch the prawns, as they live on the ocean floor. The trawl net is the most widely used of all fishing methods and catches most of the world's table fish. To get the net working Tom first gets the *Silver Moon* running at full speed. Bill, Tom's deckhand, lowers the net by releasing the trawl winch. The movement of the *Silver Moon* forward forces the otter boards apart and spreads the net open. As the open net is dragged across the sea floor much of the marine life in its path is swept up by the net and collects in a bag at the back called the cod end. Bill drags the net along the ocean floor for about three hours before he winches it back to the stern of the vessel.

Tom slows the *Silver Moon* down a bit while Bill winches the nets up and onto the deck, so that the cod end of the net (the end opposite to the otter boards) is directly over the sorting table. When Bill loosens the ropes at the cod end, the catch spills onto the sorting table — and what a collection of marine life it usually is! Although most of the catch are prawns, there are usually lots of small fish, octopus and shells, and an occasional sea snake. Interestingly, they rarely catch large fish when trawling for prawns because the boat travels too slowly and the fish swim away.

Tom spreads the catch out on the table with a large shovel, while Bill lowers the trawl down to the ocean floor again to start another catch. For the next three hours Tom and Bill sort and package their catch,

before hauling up the next load. If the prawns are for the export market, they put the prawns into the brine tank to keep them fresh, but if the prawns are for the local Australian market, they usually boil them. The Co-op lets them know in the afternoon what market it wants prawns for — it varies from day to day, usually according to the price for which the Co-op can sell them.

Until the last few years, Tom used to throw back into the sea a lot of the extra creatures he caught in his nets. But recently, the Fishermen's Co-op has been finding new markets for many of these 'trash fish'. So now Tom and Bill box whiting, octopus and several other species, and Tom finds he is usually able to pay Bill, and most of his fuel bill as well, from the sales of these 'trash fish'.

Before winching up the nets a second time, Tom and Bill have to wash down the sorting table and clean the decks in preparation for the next catch, a process they repeat until the light of early morning.

2.2.3 The Clarence River Fishermen's Co-operative

When Judy Burt goes to the Co-op in the mornings, she is never quite sure what she will be doing that day. What she does depends on what the fishermen brought in the previous evening or that morning — and that can vary widely.

Prawns are the mainstay of the Co-operative but Judy has to size-grade and package many other kinds of fish as well. Her main job is to pack them in plastic bags and then in special plastic cartons to protect them from severe drying called freezer burn.

More than 100 ocean-going trawlers and another 30 river trawlers bring their catch to the Clarence River Fishermen's Co-operative.

Any professional fisherman working from the Clarence River can become a member of the Co-operative if he has fished locally for at least two years and, as a 'non-member' of the Co-op, has paid a small additional fee on his catch during that time.

Fishermen bring their individual catches to the Co-op, which then processes them and sells them. A record is kept of the catches each fisherman brings and he gets money back from the Co-op after marketing charges and Co-op fees are deducted.

The Co-operative is a big concern — in 1979-80 it sold $8 million worth of fish.

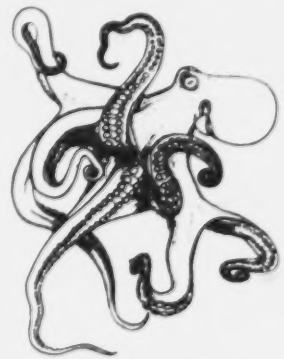
The two main principles underlying the Co-operative are:

1. Fishermen **control their own livelihoods** through careful planning and marketing, plus of course gaining a share in the profits.
2. **Avoid wastage** and secure markets for everything that fishermen catch in their trawls. By looking for markets overseas as well as at home, prawn fishermen are now able to sell what were once regarded as 'trash' or throwaway species such as octopus.

The manager of the Co-operative said recently: 'We advocate throwing as little as possible back over the side. You can't sell a product once it's back in the water. It's amazing what can be sold, provided you're prepared to search out a market. We sell shells, and at the moment I'm looking for ways to sell jellyfish.'

The Co-operative has its own factory for processing (mostly freezing) and packaging the fish. When there is a big catch and a surplus of fish — that is, more than can be sold fresh on the local and Sydney markets — the fish can now be frozen and stored for when there is a shortage. In this way fishermen are not forced to sell off their surplus cheaply to get rid of it.

Seafood that is not in great demand on the local markets, for example octopus, is frozen and sent up to Brisbane in freezer containers for shipping to some twenty overseas countries.



2.2.4 Finding Out How Prawns Live

Prawns are **crustacea** — animals that live in the sea and have hard outer coatings which seem to be jointed. This hard coating (chitin), is their skeleton and is rather like a suit of armour. Crustacea have their muscles inside the chitin. This contrasts with humans who have inside skeletons and outside muscles. There are a large number of different crustacea, most of which live in the sea. Prawns are amongst the better known and bigger members of the group. Crustacea are closely related to insects — they both belong to a group of animals called **arthropods** — animals with jointed limbs. Crustacea differ from other arthropods by having two pairs of antennae. Rock lobsters and sand crabs are other commerically important crustacea; lobsters generally live around reefs where trawls and other nets would become entangled and so are usually caught in baited traps. The diagram labels the main parts of the prawn and indicates how it moves. Despite its appearance, the covering of the prawn is continuous — the joints in fact are places where the covering is thinner, and is slightly folded. The prawns 'breathe' through gills in much the same way as fish 'breathe'. Sea water is passed across the gills, and oxygen taken from the water through the membranes of the gill walls. Prawn gills are hidden from view under their shell 'carapace'.

The major commercial prawns in Australia are called penaeid prawns. Among these prawns, males attach a sperm 'packet' at the base of the females' walking legs. The eggs are fertilised inside the females' bodies. Soon after the eggs are fertilised, the female prawns release their eggs into the ocean waters where they float as part of the plankton. Once the eggs are released, the young prawns are on their own. They prefer warm waters, and the adults like the shallower continental shelf areas. They breed in ocean areas away from the shore.

In common with all crustacea, prawns successively shed their outer casings as they grow. After each **moult**, they grow a bit before the next case hardens. Have you ever seen an insect case (such as a cicada case) which has become too small for the growing insect, so it has shed it?

As part of the plankton, prawn eggs are at the mercy of ocean waves and currents. Once the young prawns hatch, their early form and shape are quite different from their adult form. Through their successive moults, as they grow, they gradually take on their adult form. During the early **larval** stages of prawns, when they are very small, they might moult every few hours, then every few days, then weeks. Finally, they moult only once a year. Prawns usually live for two to three years.

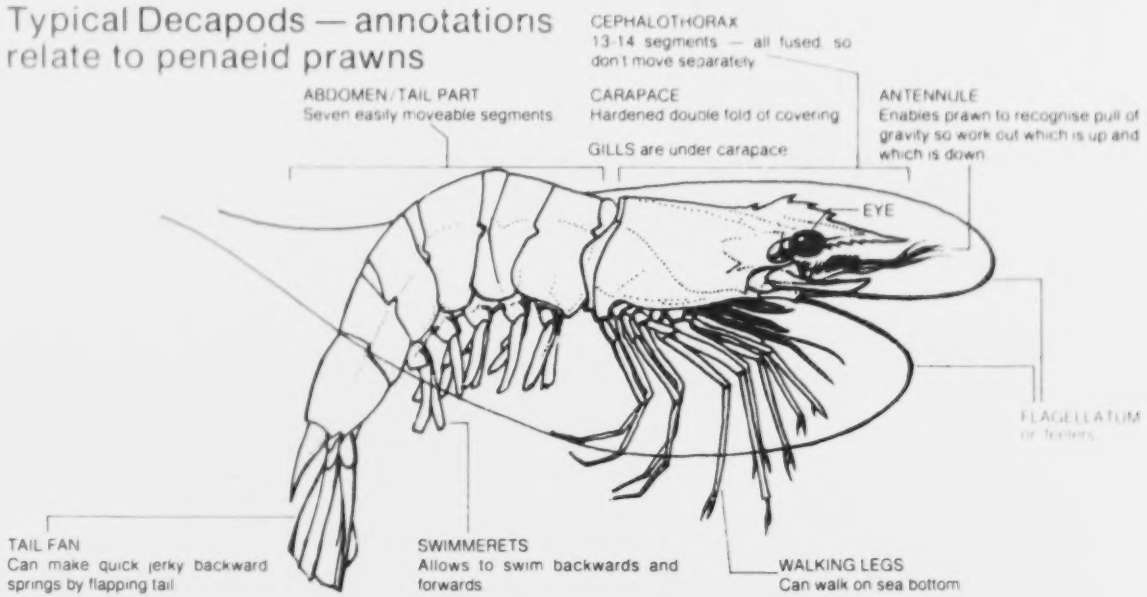
When the prawn begins to moult, it makes a new soft skin under the old skin. The old skin softens when the prawn reabsorbs calcium salt from along the top of the carapace, where the old skin will split open. Just before the prawn sheds its skin, it will often find a secluded spot where it will be relatively safe from predators when it emerges with a soft skin. Then the prawn absorbs a lot of water, and the old skin splits open. The prawn gradually extracts itself through the split in the shell, leaving its old shell otherwise intact. The prawn pulls its flesh away from the inside of the old shell, and extracts each limb very carefully — much as we would carefully extract our hands from well fitting gloves.

The old skin left behind is not wasted, because it is a rich source of protein and minerals. Some animals eat their own moult to get back their supply of these proteins and minerals. In other cases, various ocean scavengers quickly eat the old shell.

When still very small, the young prawns migrate from the ocean to rivers and estuaries on shore where they find abundant food in the muddy bottoms around seagrass beds and mangrove swamps. They grow rapidly during this stage. When they are almost mature, they migrate back to the sea, where they remain for the rest of their adult life, and where they breed.

Some prawns live and migrate in schools — a habit which makes the fishermen's task easier.

Typical Decapods — annotations relate to penaeid prawns


CEPHALOTHORAX
13-14 segments — all fused, so don't move separately
ABDOMEN / TAIL PART
Seven easily moveable segments
CARAPACE
Hardened double fold of covering
GILLS are under carapace
ANTENNULE
Enables prawn to recognise pull of gravity so work out which is up and which is down
EYE
FLAGELLATUM
or feelers
TAIL FAN
Can make quick jerky backward springs by flapping tail
SWIMMERETS
Allows to swim backwards and forwards
WALKING LEGS
Can walk on sea bottom

2.3 Salmon Fishing in Oregon, USA

This section looks at the **historical** development of a fishing industry over a period of 100 years.

It shows the way in which the Indian fishing culture in the area was taken over by a huge canning industry — in other words how a **subsistence** fishery became a **commercial** and **industrialised** one.

It also shows the impact these changes had on the development of the state of Oregon.

The following extract is taken from the booklet, *Fish or Cut Bait* by Courtland L. Smith.*

Introduction

The innovation of canning salmon changed salmon in Oregon from subsistence fare for settlers and Indians to a commodity sold worldwide. The first cannery on the Columbia River opened at Eagle Cliff, Washington Territory, in 1866.

Before 1866, fishing was primarily inshore to feed settlers and Native Americans. From 1866 to 1934, the salmon industry grew to worldwide importance.

The Foreigners are taking our fish

Harvesting such natural resources as furs, fish and timber for commercial sale was introduced to the Oregon country by Euroamerican settlers in the early 1800s. The idea of **commerce, the developing of natural resources for sale elsewhere**, was foreign to the Native American inhabitants of the Columbia Basin. For Euroamericans, development and trading of natural resources was one of the dominating cultural traits which stimulated their exploration and colonisation of vast areas of the world.

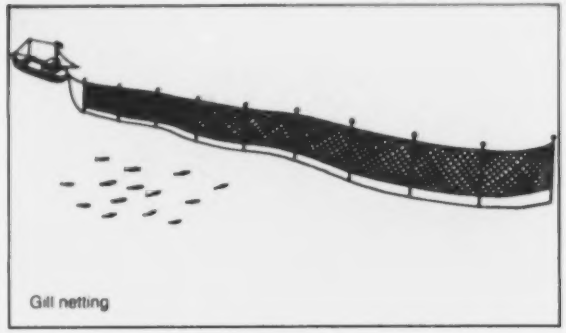
Native Americans inhabiting the Columbia Basin did trade their fish resources with neighbors. They did not, however, seek markets solely for personal or group economic gain. Seeking a shorter trade route to the East, James W. Cook explored the Pacific Coast. Robert Gray, discoverer of the Columbia River for colonial America, did so on a fur trading mission. Gray's objective was to trade cloth, brass buttons and chisels with Native Americans for pelts which he would then trade in China for tea. Lewis and Clark's journey to the Northwest was to discover the area's

wealth and ways for the new American nation to exploit it.

From the 1830s attempts were made to market the salmon resources of the Columbia River. Means for preservation and storage limited these attempts to only a few relatively minor salt salmon fisheries. Preservation in cans was the innovation which created the potential for marketing the Columbia River salmon runs.

Canning was a French innovation. Nicholas Appert published, in 1810, the results of his work on food preservation in the book entitled, *The Book for All Households, or the Art of Preserving Animal and Vegetable Substances for Many Years*. Applying knowledge of canning to salmon, William and George W. Hume, with the technical assistance of Andrew S. Hapgood, began canning Sacramento River salmon in 1864. The Humes were of Scottish heritage, born in Maine and migrating to California seeking wealth in the gold rush. Their first canning attempts on the Sacramento were frustrated by reduced salmon runs caused by hydraulic mining, overfishing and stream obstructions. In 1866 they shifted their operations to the Columbia River. On the Columbia, salmon canning rapidly took hold. Astoria was founded in 1811 as a fur trading post. By the 1880s it was the world centre for the salmon industry. In 1886 Columbia River canneries provided over 50 per cent of the salmon pack. Sales prior to the turn of the century were made in North and South America, Europe, Australia, Polynesia, India, Africa and Japan.

The U.S. Census of 1880 was taken in June. It reflected the dominance of the canned salmon industry on the economy of Astoria and Clatsop County. The County's population was 7 055. Nearly one-third — 2 252 — were Chinese, and three-fourths of the Chinese worked in the salmon canneries. Chinese labourers had been introduced by George W. Hume in 1872 because of the unreliability of the white seasonal workers.



Gill netting

Most of the fishermen were gill-netters and gill-netting could be a dangerous business. Death was

*Reproduced with the kind permission of the Oregon State University Sea Grant College Program Publication No. ORESU-T-77-066.

frequent for the early sail-powered gill-netters. Fishing too close to the bar, inaccurate tide information, overloaded boats, storms, inexperience, drunkenness and a high, fast river all contributed to the death toll. Being washed across the bar and out to sea was one of the most common hazards facing gill-netters. On the night 3 May 1880, a sudden Southwest storm hit, compounding the hazards to fishermen. Over 20 died that night, helpless at the mercy of the elements. Mr Acklan reported, 6 May 1889, in the *Daily Astorian*, that he saw two men on the bottom of their gillnet boat heading for the breakers. He said that he 'could do nothing to save the men, and they bid him farewell by tipping their hats as they entered the jaws of death.'

The Corps of Engineeers made studies of the navigation hazards beginning in 1882. In an 1887 report Captain Charles F. Powell said, 'The prevention of gillnet fishing near and on the bar would result in a saving of life, some 20 to 60 fishermen are drowned there each year.'

The hazards of fishing were played down because competition among canners for fish forced the retention of as many fishermen as possible.

When salmon canning commenced on the Columbia little else was going on. Oregon had been a state for only 7 years and Washington was still a territory.

The population of Oregon and Washington was only 115 000 in 1870. By 1880 it had more than doubled to nearly 250 000. Given the salmon pack estimated to be 530 000 cases of 48 one pound cans, this would have provided each inhabitant of the two states with 100 pounds of canned salmon. Salmon and potatoes, however, were the staple diet of many residents. The major value of the salmon pack was as a generator of jobs and new income. This was very different from the subsistence and cultural value which the salmon resource had for the Native American populations of Oregon and Washington whose fish the settlers were taking.

As for the Indians: the 1850s were the low point of the Native American fishery. Since that time, they have waged a steady fight in the courts and elsewhere to regain their lost fishing grounds.

In 1885 treaties were agreed to between the United States and the various tribes in the Northwest. Each of these treaties granted Native Americans 'the right of taking fish at all usual and accustomed places, in common with citizens of the Territory.'

Since then there have been many disputes arising out of the treaty and the Indians have sought to have their rights upheld in the courts.

For further reading see *Fish or Cut Bait*, by Courtland L. Smith.

1.0 Fresh or Frozen

1.1 The Fish Market

Once the fisherman has made his catch, he must find a way of selling it.

Some fishermen, like Tom Burt in Section 2.2, sell directly to processing factories where the fish are canned or frozen.

Other fishermen send their fish to a **large central market** in the city.

The fish market is a large and colourful place where every variety of seafood can be found.

The fish is sold, in lots, at **auction**, that is, to the highest bidder.

If you buy fish at a market you can be sure of getting it reasonably fresh although a good fish shop will buy fish fresh from the market every day.

All seafoods are at their best when they are very fresh. The flavour is best, and the food value is best. Once fish are dead, the quality deteriorates quite quickly unless the fish are processed or preserved in some way to keep their quality.

As consumers of seafood, we should all be interested in what happens to fish from the time they are caught until the time they reach our plate. In this section, we will be looking at ways of keeping fish at top quality.

Fish Market, Japan.

Fish Market, Australia.

Fish Market, Tonga.

Why Fish Need to be Preserved to Stop Loss of Quality

Once a fish is dead, it stiffens almost immediately. Its flesh becomes firm and elastic, a condition known as **rigor mortis**. Rigor mortis does not last for long, however, and the fish gradually loses its stiffness. The best time to eat the fish, in terms of flavour and food value, is just after rigor mortis has passed.

Following rigor mortis various other changes occur in the fish, some of an **external** nature which help indicate the quality of the fish, and others of a **chemical** nature which affect the quality of the flesh.

There are two main chemical changes both of which lead to loss of quality in the fish. Like other animals, the tissues of the fish contain **enzymes** which, on death, digest or break down the tissues. This causes the tissues to get soft, and to change in flavour, colour and smell. This process of ripening is called **autolysis**. In red meats these changes are desirable as they make the meat tender, juicy and of good flavour. To our tastes, though, the process is not so desirable in fish.

The second chemical change is **putrefaction**, which happens when certain bacteria invade the fish. Prime targets for the bacteria are the fish's gills and intestines, and the slime of the skin.

Most fishermen pack their catch in ice on the boat so as to keep their fish fresh. If you are buying from a boat, a fish market or a fish shop, look for these signs.

Characteristics of Fresh and Stale Fish

Good Fish	Bad Fish
Skin and colours bright	Skin dull, spotted or slimy, pale or bleached
Scales adhere strongly	Scales loose
Eyes clear and not sunken or wrinkled	Eyes cloudy, wrinkled, sunken
Gills red	Gills yellowish, grey, brown
Flesh firm and elastic, finger impressions do not remain	Flesh flabby and soft, finger impressions remain
Smell like fresh seaweed at exterior and gills	Smell stale or sour, especially at gills
Little slime on skin	Skin slimy (usually)
Body rigid or stiff	Body flabby or limp

1.2 Ways of Preserving Fish

The best way to eat fish is to eat it fresh and to buy it from a fish shop or a fish market. But this is not always possible, and for this reason preserved fish is also an important part of the human diet.

In this section, we are going to investigate how a number of processes help preserve the quality of the fish for a reasonable length of time from the day it is caught.

In all of these processes, the aim is either to destroy the bacteria and enzymes which cause the fish to spoil, or to slow down their activity to such an extent that spoilage is so slow that the product will be usable over a reasonable length of time.

There are **five major principles** which are used in different processes of preserving fish. The principles are:

lowering temperature
raising temperature
removing moisture
making antiseptic
removing air

The most commonly used processes of preserving fish are chilling and freezing; salting; drying; smoking; pickling; canning. Some of these processes employ more than one principle of preservation.

1.2.1 Chilling and Freezing Fish

It is best to keep fish chilled from the time they are caught, if possible. This is why fresh fish on sale in fish stores is usually packed in crushed ice.

Before the development of modern refrigeration, it was well known that food, and especially perishables like fish, keep longer at cooler temperatures. Cool cellars under houses were often used for storage. During the winter in the cool countries, some people packed naturally occurring ice in sawdust to keep perishables cool into the spring and summer.

In the mid 19th century artificial methods were found for manufacturing ice using a refrigerator. The inventor was an American, Jacob Perkins. Refrigeration is a process of drawing heat out of substances to lower their temperatures. An electric refrigerator like those in many houses, circulates a refrigerant (some times ammonia or a freon compound). The heat it draws in from the refrigerated space turns the liquid refrigerant into a gas. When this is passed on the outside of the refrigerator, the refrigerant cools down (loses its heat) and turns into a liquid again. As the refrigerant is in a 'closed system', the process is repeated continually, as long as there is power (electricity) to circulate the refrigerant.

If fishing boats are going to be out of port for some time, they will generally use some form of refrigeration on the fish while at sea. Smaller boats might just have a large supply of crushed ice. 'Wet trawlers' are trawlers which keep the fish in tanks of refrigerated brine — fish keep top quality for three to four days in this way. The larger freezer trawlers have large freezers on board where they can freeze the fish very soon after they are caught.

If fish are frozen rapidly, there is no real change in the flavour of the fish once it is thawed. That is, of course, if the fish is properly cared for and not allowed to 'dry out' or dehydrate in the freezer. Fish must not be exposed inside the freezer. They can be glazed with water or covered (e.g. with plastic).

It is important to remember **never** to refreeze raw food which has been thawed, unless you cook it before refreezing it. Could you suggest why?

Fish which are going to be processed in some other way are often chilled or frozen while they are 'waiting' to be processed. Could you suggest why?

1.2.2 Salting

Salting is one of the oldest known ways of preserving fish (and other meats as well). Salting is not so common as a preservative now that refrigeration and canning have been developed.

Salting acts as a preservative for fish because it is a process which removes water from the fish. Both types of spoilage of fish depend on the presence of water for them to take place. Water constitutes about 60% or more of the weight of the flesh of fish. This must be reduced to around 9% water content, for the fish to become stable at room temperature — i.e. in a condition where it will not spoil.

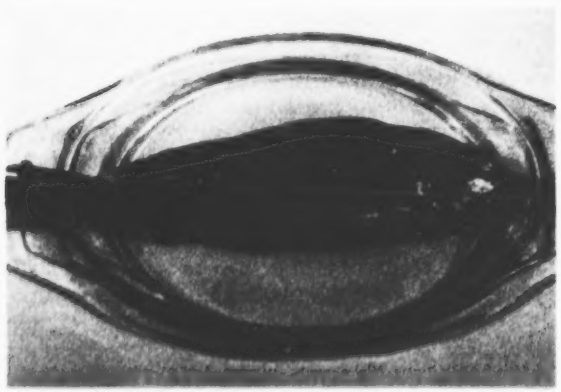
Salting removes water from the fish by the process of **osmosis**. In osmosis, which occurs in all forms of plant and animal life, nutrients in solution are able to pass through the semi-permeable cell membranes and into the body, while at the same time, certain other substances pass out of the body. When fish are placed in a strong salt solution, water from the fish passes out through the fish's cell membranes into the salt solution and some salt passes into the fish's body. The flow of water through the cell membranes is always from the weaker to the stronger solution. Osmosis continues until the concentration of the solution inside the cells of the fish equals that of the brine. At this point the salting process is finished, and the fish are said to be 'thoroughly stuck'.

1.2.3 Drying

Any seafood can be dried. Before drying, seafood is often cooked first.

Drying preserves fish by removing moisture from it. As with salting, the lack of moisture in the final product stops or slows down the two processes which spoil the fish.

Drying is also an ancient method of preserving food, found in many cultures around the world. Drying can be done in the open air, as long as there is sufficient wind and the air is not too humid (humidity over 75% makes open air drying difficult). Why do you think these conditions are necessary? For these reasons, sun and wind drying have been more common in temperate and higher latitudes, although in some parts of the tropics, such as the southern Philippines and parts of Indonesia, the natural conditions allow open air drying. In East Asia, in Japan and China, dried seafood is extremely common, and a wide variety can be found at markets. Dried squid is very common.



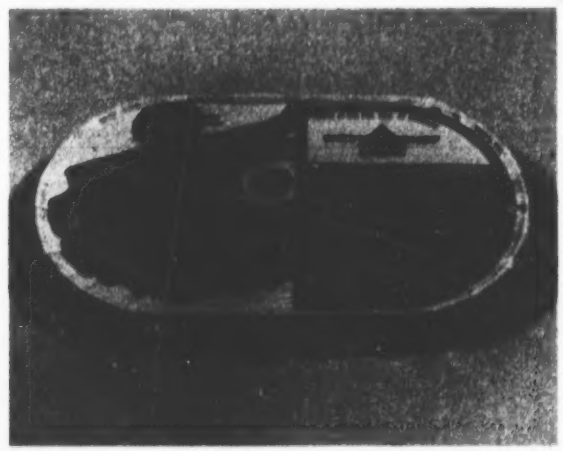
Drying in the open air is a race however — to make sure the fish loses its water before it spoils. This is why humid weather is not good. A further hazard to open air drying is that flies often lay their eggs in the drying fish while they are still moist, causing the fish to become fly-blown. Smoking and drying are often used together in preserving fish

A number of artificial ways of drying fish have also been developed — more commonly referred to as **dehydration**. These have included vacuum drying, freeze drying, spray drying, cabinet driers or conveyor belts.

1.2.4 Smoking

Like salting, and drying, smoking is a very old process whose origins are not known.

When we talk about smoking fish, we are really referring to a process which combines four elements — salting, drying, heat treatment, and smoking.



The main purpose of **smoking** is to give the fish the distinctive smoked flavour and colour. The smoking itself does not add much to the preservation of the fish, although it has a mild antiseptic effect. Smoking is effective, however, in stopping flies and other insects from infecting fish while they are being dried. Smoked fish has a deep brown colour which comes from compounds in the smoke, which are deposited on the fish, and darken when they are exposed to oxygen. Almost any kind of hardwood can be used for smoking fish and different woods give distinctive flavours to the fish. Softwoods are not recommended because they have a large amount of resin which gives the fish an acrid flavour.

1.2.5 Pickling

Pickling stops the deterioration of the fish by putting it into an antiseptic environment. Pickling fish involves putting it into a mixture based on vinegar. It is the acetic acid present in all vinegars which acts as the antiseptic, and slows down the spoilage of the fish to a very small rate. Pickled fish keep for a long time, although not indefinitely, so it is as well to store them in a cool place. Seafoods often pickled are — mussels, scallops, roll mops, Bismark herrings, herring fillets, anchovy fillets, octopus and squid.

1.2.6 Canning

Canning is a relatively recent method of preserving food, discovered in 1795 by the Frenchman, Nicholas Appert. One advantage of canning is that it keeps the original flavour of food to a large extent, which traditional methods of preservation, such as salting, and drying do not. Canned foods also can be easily transported, and kept in any climate without marked deterioration. Canning is an expensive process, however, so it is economic only if the food is available in large quantity.

Canning is a process where perishable foods, such as fish, are hermetically sealed in a container —sealed so that air cannot get to them and cause the products to deteriorate.

Some fish are pre-cooked before being put into cans.

Once the cans are sealed, they are then sterilised by heat. The cans are heated to a temperature sufficiently high to kill the bacteria and to stop the enzyme action. The temperature and the time necessary for sterilisation varies according to the product. This step is sometimes called the final cooking. Canned products do not need to be cooked again on opening before being eaten, although they are often tastier if heated.

During the 19th century, canning factories were set up in many countries. An example of the revolutionary role that canning played in various fishing communities is illustrated in the extract (p.31) on the salmon canning industry of the West Coast of the USA. Today, common canned seafoods are tuna, salmon, sword-fish, sardines, herring, anchovies, smoked oysters, caviar (the roe, or eggs, of certain fish, — originally only of the sturgeon), shrimp and crab meat.

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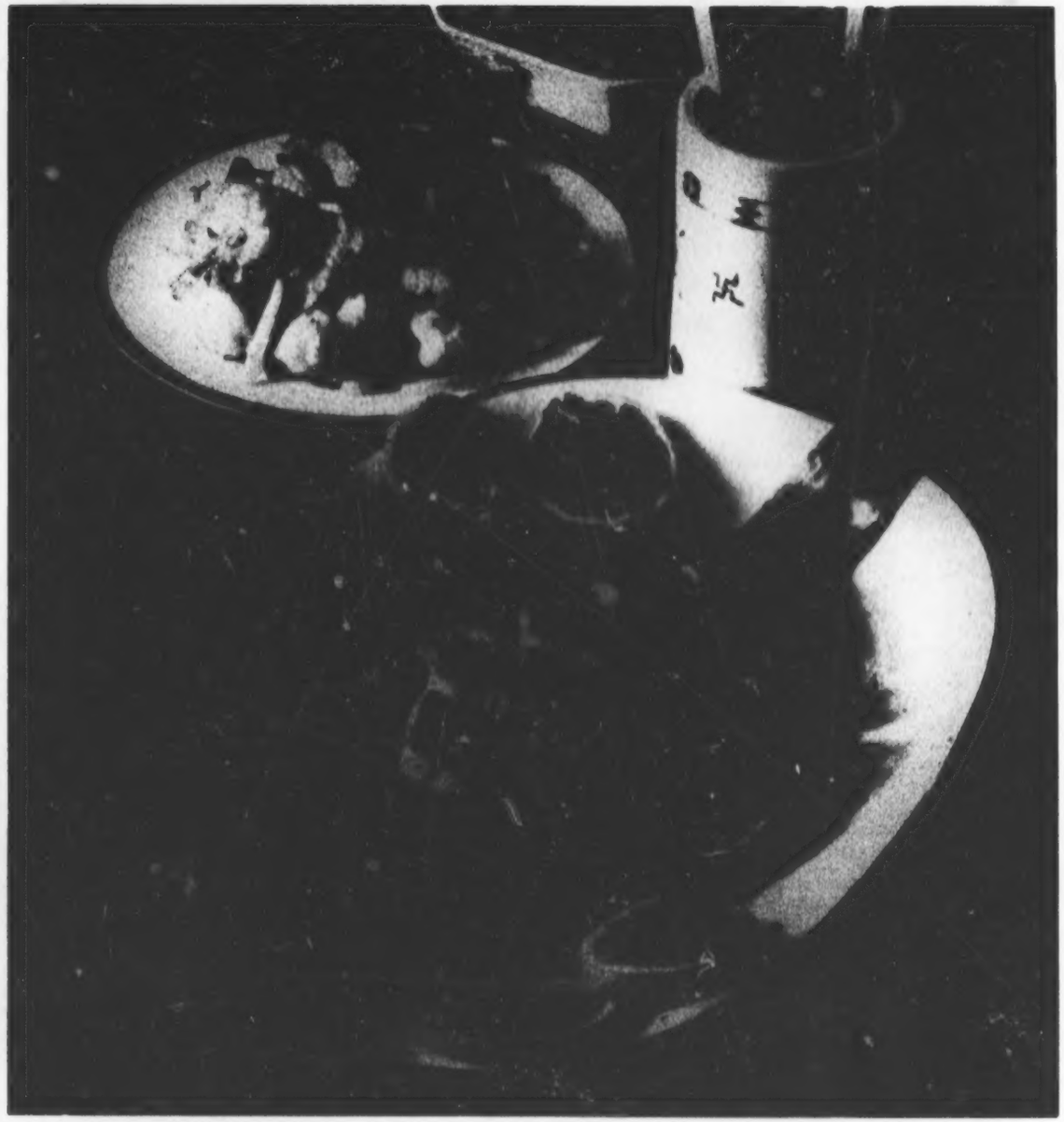

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Tempura Restaurant, Tokyo

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2.0 Nutrition and the Ocean

For years, prophets of doom have been warning us that the world is going to run out of food. At the same time optimists have been insisting that the answer to many of our food and nutrition problems lies with the ocean. The globe is 71% ocean and yet less than 2% of the world's nutrient supply comes from the sea. Learning to farm the ocean seems like the simple solution.

But, as with most 'simple' solutions, complexities develop as we begin to delve more deeply into the questions. Since many of the questions are ethical ones, with no straight forward answers, you will have to do some thinking and make some hard decisions about what kinds of policies world governments should be considering when it comes to the use of our ocean's nutritional resources.

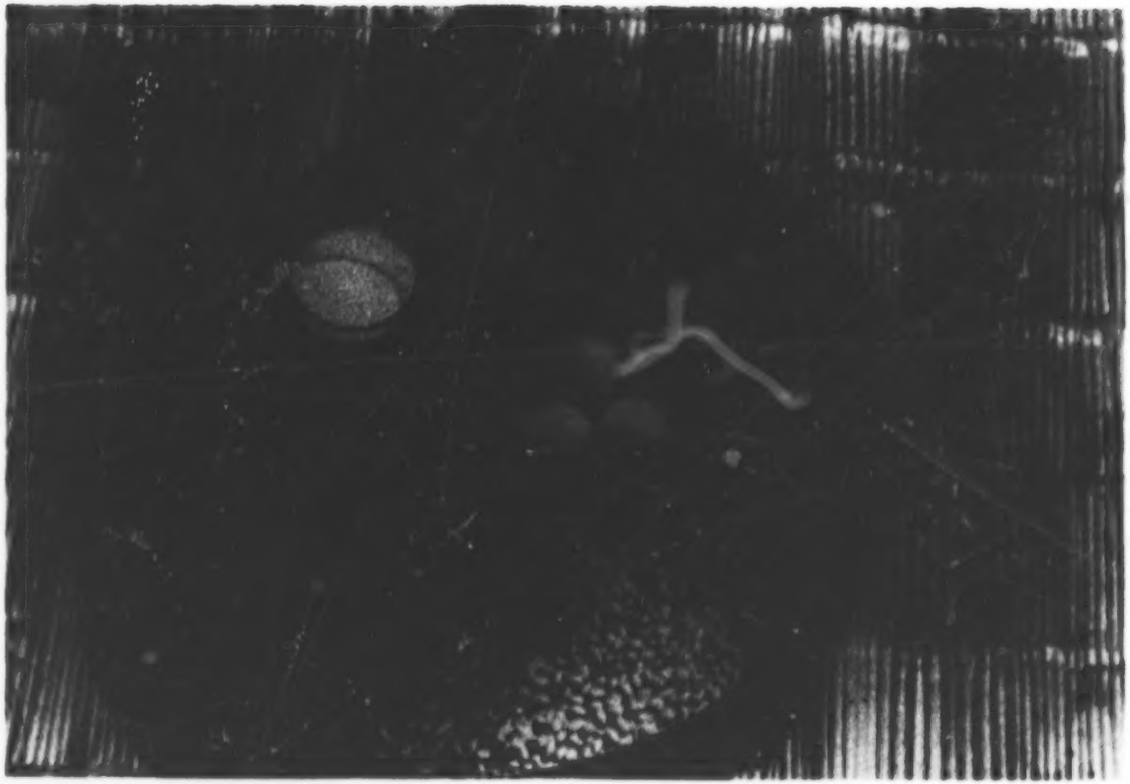
2.1 Global Malnutrition — The Problem That Won't Go Away

We live on spaceship earth. But we are not proving ourselves to be very effective caretakers of our spaceship. We cannot continue our present practices without there being catastrophic results.

Indeed, catastrophic results are already in evidence. World renowned food scientist Georg Borgstrom writes:

> Mankind has by and large failed in its supreme effort to feed adequately those billions of people living on earth. Of these, around one and a half billion are undernourished, and the diets of an additional one billion are deficient in one or several key nutrients.

An answer to problems of malnutrition generally requires a solution to protein-deficiency malnutrition. Protein-deficiency malnutrition results in a disease called kwashiorkor. Kwashiorkor is common among young children who are weaned from mother's milk (often because of the arrival of another child) and



who have no other source of complete protein available to them. (Note: proteins can be of two types — complete and incomplete. Complete proteins contain all of the amino acids necessary for building and repairing of body cells. Incomplete proteins cannot sustain growth unless combined with complete proteins or with other incomplete proteins which can complement their amino acid deficiencies.)

All forms of fish are excellent sources of complete protein. This is one good reason to look to the ocean when we realise that our capacity to supply the world's population with such other complete protein commodities as milk, eggs, cheese, meat and poultry is limited. Of course, like most other foods, fish do not carry just **one** nutrient. Fish are also excellent sources of vitamin A and vitamin D and such minerals as iodine and calcium and phosphorus. The calcium and phosphorus content of fish is especially high in the case of small fish such as sardines where the bones as well as the flesh are consumed. Fish also provide the body with necessary energy in the form of kilojoules. (In general, the more oily the fish, the greater its kilojoule content).

2.2 Waste Not - Want Not.

While many people starve, people in prosperous countries become more and more sensitive about what kinds of and/or portions of fish they will eat. In relation to this point, examine the following 'evidence'. Think about the ethical questions and the practical problems which each piece of 'evidence' raises.

(i) 'Evidence' One.

The following chart shows the apparent per capita consumption of seafood in Australia from 1938-1980:

Apparent Per Capita Consumption of Selected Foodstuffs, Australia
(kg per year, except where otherwise stated)

	Average 3 years ended					
SEAFOOD	*1938-39*	*1948-49*	*1958-59*	*1968-69*	*1978-79*	*1979-80*
Fresh and frozen (edible weight) —						
Fish —						
Australian	2.7	2.4	1.4	1.4	1.6	1.5
Imported			1.4	1.9	1.6	1.1
Crustacea and molluscs	0.3	0.3	0.4	0.8	0.9	0.8
Seafood, otherwise prepared (product weight) —						
Australian	1.9	1.4	0.4	0.4	0.5	0.5
Imported —						
Fish			0.8	1.0	1.8	1.9
Crustacea and molluscs					0.4	0.3
Total seafood	4.9	4.1	4.5	5.6	6.9	6.1

Source: *Apparent Consumption of Foodstuffs and Nutrients, Australia, 1979-80*. Catalogue #4306.0. Australian Bureau of Statistics, Canberra.

What are the Australian trends in seafood consumption? What factors might explain the trends you have noted? What are the implications of Australia's seafood consumption patterns for the 'have not' nations?

(ii) 'Evidence' Two

In the past twenty years the net weight of fish caught increased from 30 to 70 million tonnes but the proportion of the catch used as human food diminished from 83% to 63%. The rest was turned into fish meals and fed to animals — mainly in the already well-fed countries. Thus the USA and West Germany buy nearly half the fish meal produced by Peru — and Peru has a protein deficiency.*

Do you see this situation as a problem? If so, who do you believe is at fault — the USA and West Germany for purchasing the protein-rich fish meal or Peru for selling it? Why? Why do you think Peru does sell her fish meal instead of using it to help solve her nutrition crisis?

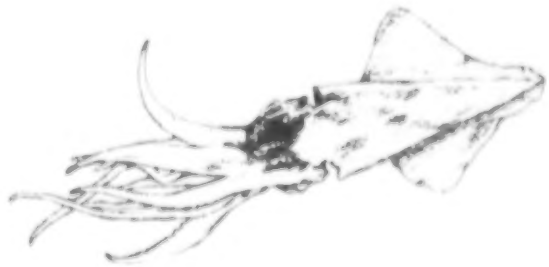
The fish meal described above is often made from portions of the fish not generally considered fit for human consumption (e.g. the gut). We consider it to be perfectly acceptable to eat the gut of such things as oysters, sardines, and whitebait, yet not the guts of larger fish, despite the fact that there is no evidence that such fish portions are harmful if sterilised. What solutions can you think of to deal with food taboos of this nature? Are they long-term or short-term solutions? In thinking of solutions, it might help you to remember that we humans are a curious lot — as evidenced by the fact that when introducing hake on the Chilean market, entrepreneurs presented two products (identical except for name and price). Which product was the most successful? You guessed it — the more expensive one!

There is another problem. People like to eat food that they are familiar with. They don't like to eat anything strange, even though it may be very nutritious. Take **squid** for example. It is a highly nutritious and very reasonably priced source of protein, but it is extremely difficult to sell, except in countries where it has been part of the traditional diet such as Japan.

Is this because people don't like the look of squid and associate it with one of the legendery 'monsters' of the ocean, the octopus?

Whatever the reason, this kind of 'buyer resistance' is a serious obstacle to making the best use of our ocean resources. Fisheries experts estimate that there are between 50 and 60 million tonnes of squid that could be harvested every year without endangering the species. That's as much as the total world harvest of other fish! At the moment the annual world catch of squid is between ½ and 1 million tonnes and even this exceeds the current demand among consumers. A cast source of food lies untapped!

Can you think of ways in which this problem could be overcome?



* Pirie, N.W., Food Resources —*Conventional and Novel*, Penguin Books Ltd., 1976.

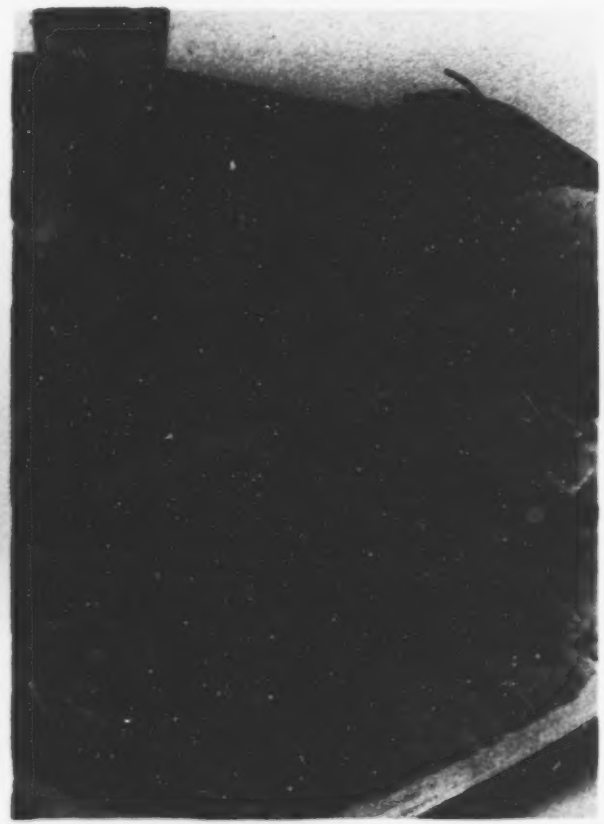
The Micro Decision Has a Macro Impact

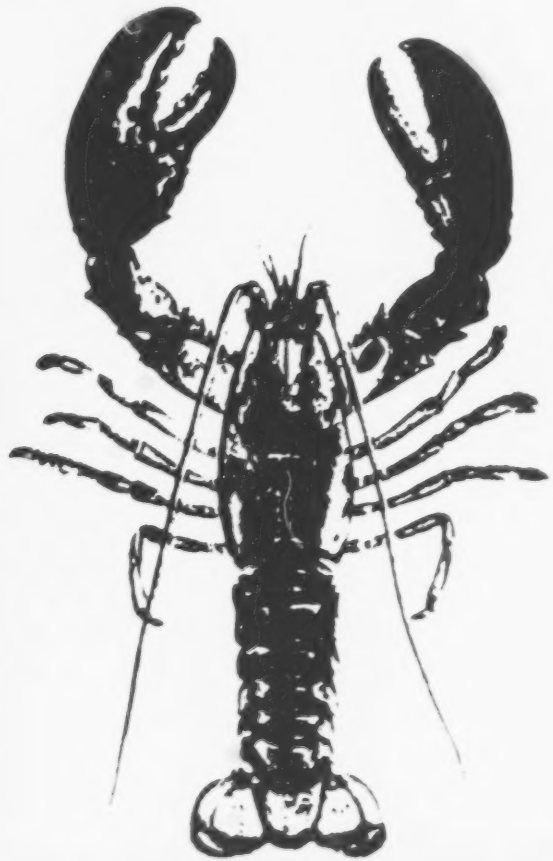
One of the most difficult concepts to 'hang onto' is the notion that the micro decision has a macro impact. Have you ever heard the expression — 'what if they called a war and nobody went?' This expresses the notion of the power of the micro decision. While you **alone** can do little to change our nutrition/sea policies — a whole lot of 'yous' all saying the same thing could have a lot of influence. What would happen, for example, if all people in developed countries were to stop buying pet food which had in it fish resources — arguing that such resources **should** be used for human consumption?

What other small steps can **you** as an individual, or your class at school, or your community do to help ensure that we use the nutrition resources of the sea carefully?

2.3 Food — A Reflection of Changing Attitudes

The popularity of various foods changes from time to time and from place to place. Foods, like fashions, go in and out of vogue. Think for example about lobster. Cold water lobster from the eastern seaboard of Canada and the U.S.A. is considered a great treat. It is shipped alive to fine restaurants all over the world. Consumers in such cities as London, Tokyo, Paris, Hong Kong and Vancouver are willing to pay a high price for the privilege of selecting a lobster from a tank and having it dropped alive into boiling brine. But lobster has not always been so esteemed. Lobster was once so plentiful that it was scorned. Indeed, at the end of the 18th century in the state of Massachusetts in the U.S.A. there were laws **restricting** the number of times a week black slaves could be fed lobster! Can you think of other foods which have lost or gained in status over the years? What factors besides **availability** might cause the status of foods to change? Are all of the factors **rational** ones? What does this idea tell us about people's relationship to their food?





2.4 The Effect of Changing Diets: Tonga — A Case Study

Traps set on shallow reef flats account for about 30 per cent of Tonga's fish catch.

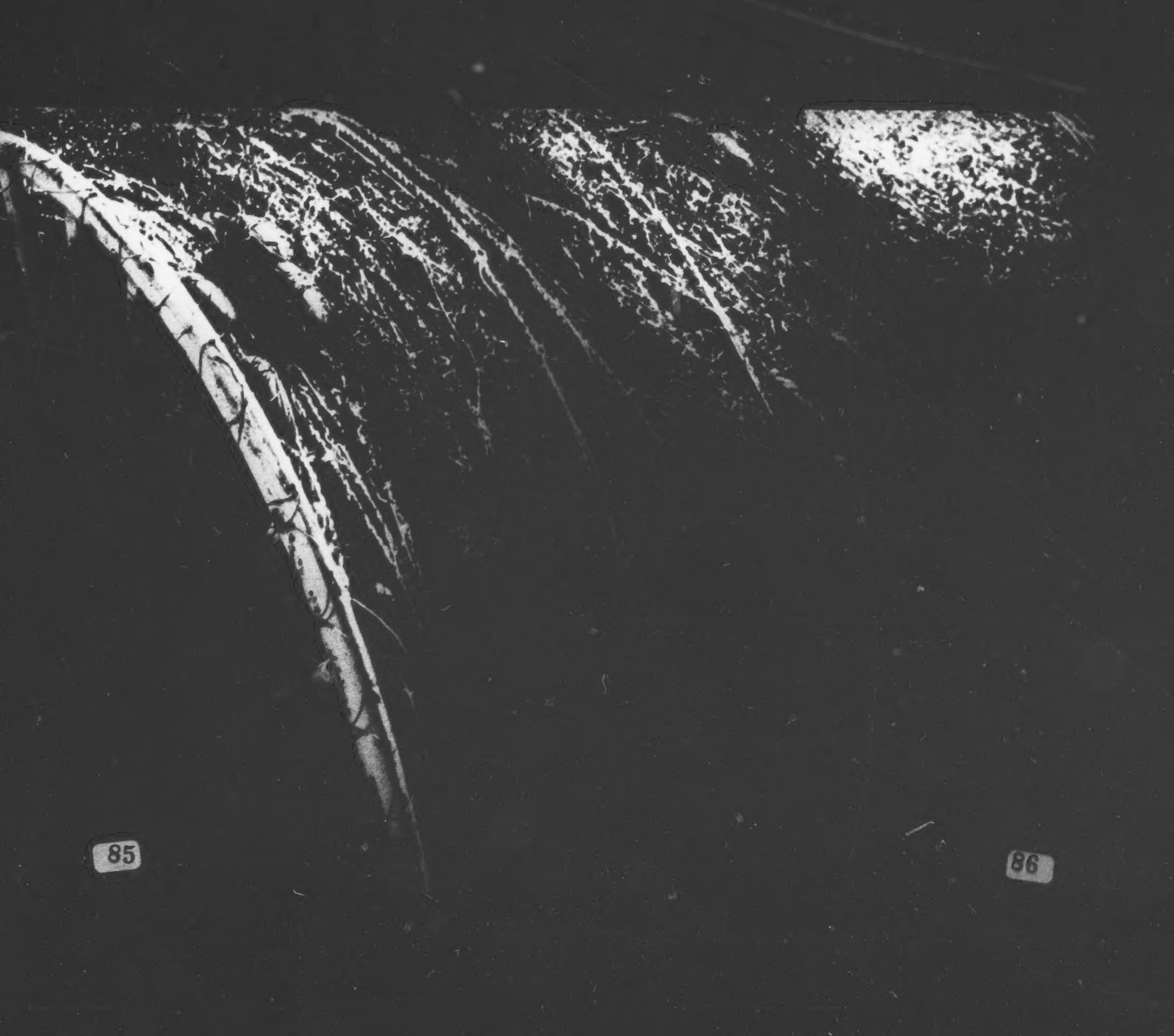
In order to examine the effects of changing food patterns, let us look at the South Seas island of Tonga. Tonga is located about 4 800 km south east of Honolulu. Traditionally the Tongans were ocean-dependent people.

Seafoods such as giant prawns, turtles, clams, rock snails, sea urchins, *beche-de-mer,* trevally, bonito, mullet and shark were important items in the Tongan diet. But with the coming of western influence and as inshore areas have become depleted, fish and therefore protein has become less prevalent in the diet. The yams, cassava, sweet potatoes and tropical fruits such as paw paw, breadfruit, coconut and bananas, traditional to Tonga, are now being supplemented with such western innovations as bread, sweets and coke. The result is a diet high in carbohydrate and low in protein. Fish has become an expensive luxury available only to the rich. Little medical research has been done to determine what the effects of these changes in the Tongan diet have been. However, the Australian home economist Dawn Spencer, who has been working in Tonga on an aid scheme, reports that the problems generally associated with high carbohydrate diets (i.e. obesity, heart disease, diabetes, and dental caries) appear to be on the increase.

Obviously there is no simple solution to the nutritional problem faced by the Tongan government. Many factors are inter-connected. The Tongan government is currently experimenting with using special bean crops (e.g. wing beans) as a useful source of protein.

Can you think of other places besides Tonga where traditional food patterns have been replaced with patterns less desirable nutritionally? Why do these kinds of shifts in diet occur? How might some of the negative outcomes of such shifts be prevented or reduced?

Tongan lure hook made from whale-bone with inlaid base plate of shell and turtle shell point.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Glossary of Terms

arthropods	Animals with jointed legs and external skeletons, e.g. crustacea and insects.
atoll	A coral island consisting of a ring-shaped reef enclosing a lagoon.
Brailing	Scooping fish out of a net with dipnet (as in purse-seining).
bunt	A pocket in the purse-seine net into which the fish are collected before brailing begins.
calcareous	Composed of or containing lime or limestone.
carapace	The upper body shell at the front of crustacea, e.g. shrimps, prawns.
chitin	The hard organic substance which forms the shell of crustacea.
colony	A number of animals or plants living or growing together.
commercial	To do with trade; produced for mass consumption with profit as a primary aim.
community	A body of persons living together.
crustacea	Arthropods that have two pairs of antennae, e.g. lobsters, crabs and prawns.
culture	The total human behaviour patterns and technology communicated from generation to generation.
debris	The remains of anything broken down or destroyed; ruins, wreck, rubbish formed by destructive operations.
ecosystem	A group of plants and animals which are interdependent and within which energy is recycled by animals and plants feeding on each other.
environment	Surroundings; the conditions or influences under which any person or thing lives or is developed.
fish finder	An electronic machine which uses aimed sound pulses to locate fish by recording the time taken for the sound to be reflected from the fish back to the vessel.
gill-net	A fishing net constructed so that fish are caught by the gill covers as they attempt to swim through the meshes of the net.
habitat	The environment in which a plant or animal naturally grows or lives.
harvesting	To reap or gather in; in more general terms the product of any action or effort.
hawkers	People who go from place to place selling their wares.
hydraulic mining	A method of mining in which the force of a powerful jet of water is used to wear down a bed of gravel or earth and to carry the debris to the sluices where the particles of value are separated.
industry/ industrial	A particular form or branch of productive labour, namely trade or manufacture.
lagoon	1) An area of salt or brackish water separated from the sea by low sand banks 2) the lake-like stretch of water enclosed in an atoll.
life-cycle	Biological life-history: the series of developments of an organism from the egg to the adult state.
longline	A deep-sea fishing line used mostly by large, ocean-going vessels, e.g. Japanese tuna boats. The longline is stretched along the sea floor or buoyed near the surface with hooks on a number of branch lines.
maguro	Japanese name for tuna fish.
mollusc	Invertebrate animal which has a soft, unsegmented body, usually covered with a hard shell of one, two or more pieces, e.g. a scallop or clam but squid and octopus are also molluscs.
nutrient	A substance which is nourishing, that is, which feeds and causes to grow.
organic	Belonging to or found in the makeup of a living being.
pelagic	Fish that live near the surface of the open ocean water and generally move in the same body of water.
photosynthesis	The chemical combination caused by the action of light; in plants the conversion of carbon dioxide and water into carbohydrates brought about by exposure to light.
plankton	A collective name for all the forms of floating or drifting organic life found at various depths in the ocean.
poling	A method of fishing pelagic species in which fish are attracted to the vessel with bait or a spray of water and then caught with barbless, usually unbaited hooks on short lines attached to bamboo poles.
polyp	A type of animal which has a hollow cylindrical body with a fixed base at one end and a mouth surrounded by tentacles at the other.
predators	Animals which prey on other animals as a source of food.

protein One of a class of complex chemical compounds which contain carbon, hydrogen, nitrogen, oxygen and sulphur and which are essential constituents of living matter. On decomposition protein yields various amino acids which are an important nutrient.

purse-seine Fish net designed to hang vertically in the water like a circular curtain when the ends are drawn together. Later the bottom of the net is drawn in like a purse to form a hemisphere of net enclosing the fish within.

radar Short for (ra)dio (d)etecting (a)nd (r)anging. An electronic system or device for determining the presence and location of an object by transmitting radio signals. The signals are reflected by the object and picked up by a receiving system.

reef A narrow ridge or chain of rocks, shingle or sand, lying at or near the surface of the water.

romo The clear red shell from a mollusc that grows on Pacific reefs. Used for making shell money in the Solomon Islands.

society A group of people living together in a more or less ordered community.

subsistence Basic needs; means of support or livelihood.

technology The science of the practical arts: the knowledge and means used to produce the material necessities of a society.

thermograph A machine that records variations of temperature.

toro Belly meat from the tuna fish; a Japanese term for a famous Japanese delicacy.

tradition A statement, belief or practice handed down from generation to generation; a long established and generally accepted custom, having almost the force of a law.

trawl A bag-shaped net, the mouth of which is kept open by a beam of wood or a pair of otter boards (ocassionally towed by two vessels). The fish are disturbed by the front edge of the trawl and shepherded back into the bag and collected in the end 'sock' called the cod-end

Canoe prow from the Solomon Islands